DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	07/03/2016
Address	Unit 3 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.42	(1a) x	2.40	(2a) =	195.41	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.42	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		195.41	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	3	x 10 =	30	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) = 0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] = 0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.35	0.34	0.34	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.68 x	1.33 =	26.09			(27)
Ground floor			81.42 x	0.15 =	12.21			(28a)
External wall			20.88 x	0.28 =	5.85			(29a)
Party wall			59.28 x	0.00 =	0.00			(32)
Total area of external elements ∑A, m²			121.98					(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	44.15	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.37	(36)
Total fabric heat loss	(33) + (36) =	58.52	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	36.18	36.02	35.87	35.17	35.04	34.43	34.43	34.31	34.66	35.04	35.31	35.58	(38)
Heat transfer coefficient, W/K (37)m + (38)m	94.69	94.54	94.39	93.69	93.56	92.94	92.94	92.83	93.18	93.56	93.82	94.10	(39)

Average = ∑(39)1...12/12 = 93.69 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.16	1.16	1.16	1.15	1.15	1.14	1.14	1.14	1.14	1.15	1.15	1.16	(40)

Average = ∑(40)1...12/12 = 1.15 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.49	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.32	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	102.65	98.92	95.19	91.45	87.72	83.99	83.99	87.72	91.45	95.19	98.92	102.65	

∑(44)1...12 = 1119.84 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	152.23	133.14	137.39	119.78	114.93	99.18	91.90	105.46	106.72	124.37	135.76	147.43	

∑(45)1...12 = 1468.28 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	22.83	19.97	20.61	17.97	17.24	14.88	13.79	15.82	16.01	18.66	20.36	22.11	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	125.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	0.99	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.77	(54)
Enter (50) or (54) in (55)	0.77	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

199.33	175.68	184.49	165.36	162.03	144.76	139.00	152.56	152.30	171.47	181.34	194.53	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Flue gas heat recovery system 1 input (Appendix G1)

-23.53	-18.04	-15.48	-9.80	-7.03	-5.44	-5.21	-5.73	-5.73	-10.75	-17.86	-24.01	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.79	157.64	169.01	155.56	155.00	139.32	133.79	146.83	146.57	160.72	163.48	170.52

∑(64)1...12 =   1874.23   (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

88.30	78.30	83.36	76.29	75.89	69.44	68.24	72.74	71.95	79.03	81.60	86.70	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Metabolic gains (Table 5)

124.46	124.46	124.46	124.46	124.46	124.46	124.46	124.46	124.46	124.46	124.46	124.46	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

19.83	17.61	14.32	10.84	8.10	6.84	7.39	9.61	12.90	16.38	19.11	20.38	(67)

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

222.38	224.69	218.88	206.50	190.87	176.18	166.37	164.06	169.88	182.26	197.88	212.57	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

35.45	35.45	35.45	35.45	35.45	35.45	35.45	35.45	35.45	35.45	35.45	35.45	(69)

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)

Losses e.g. evaporation (Table 5)

-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	(71)

Water heating gains (Table 5)

118.68	116.52	112.04	105.96	102.01	96.44	91.72	97.77	99.93	106.23	113.34	116.53	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

424.22	422.16	408.58	386.63	364.32	342.81	328.82	334.78	346.04	368.20	393.68	412.82	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.92	x	36.79	x 0.9 x	0.76	x	0.70	=	107.43	(79)
South	0.77	x	5.28	x	46.75	x 0.9 x	0.76	x	0.70	=	91.01	(78)
East	0.77	x	3.60	x	19.64	x 0.9 x	0.76	x	0.70	=	26.07	(76)
West	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(80)

Solar gains in watts ∑(74)m...(82)m

245.36	423.84	591.41	745.29	841.29	836.76	806.18	735.18	645.26	471.93	295.06	209.17	(83)

Total gains - internal and solar (73)m + (83)m

669.59	846.00	999.99	1131.92	1205.61	1179.57	1134.99	1069.97	991.30	840.13	688.74	621.98	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) — 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.98	0.93	0.83	0.68	0.50	0.36	0.40	0.62	0.89	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.94	20.20	20.50	20.78	20.94	20.99	21.00	21.00	20.97	20.74	20.27	19.89	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.95	19.95	19.95	19.96	19.96	19.97	19.97	19.97	19.96	19.96	19.96	19.96	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.97	0.92	0.80	0.61	0.42	0.28	0.31	0.54	0.85	0.97	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.57	18.93	19.35	19.73	19.91	19.96	19.97	19.97	19.94	19.69	19.05	18.50	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	18.99	19.32	19.70	20.05	20.22	20.27	20.28	20.28	20.26	20.01	19.43	18.92	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.84	19.17	19.55	19.90	20.07	20.12	20.13	20.13	20.11	19.86	19.28	18.77	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.96	0.91	0.79	0.62	0.43	0.29	0.32	0.55	0.85	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	659.97	813.21	906.94	897.17	749.35	509.13	327.79	345.63	545.61	711.31	666.07	615.43	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1376.72	1349.03	1232.20	1030.65	783.22	513.49	328.23	346.41	559.68	866.30	1142.39	1371.17	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	533.27	360.07	241.99	96.11	25.20	0.00	0.00	0.00	0.00	115.32	342.96	562.27	

∑(98)1...5, 10...12 = 2277.19 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) — 27.97 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)	0.00	(201)
Fraction of space heat from main system(s)	1 - (201) = 1.00	(202)
Fraction of space heat from main system 2	0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] = 1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) = 0.00	(205)
Efficiency of main system 1 (%)	93.00	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	573.41	387.18	260.20	103.35	27.10	0.00	0.00	0.00	0.00	124.00	368.77	604.60

∑(211)1...5, 10...12 = 2448.59 (211)

Water heating

Efficiency of water heater

90.10	89.46	88.28	86.08	83.65	82.30	82.30	82.30	82.30	86.46	89.25	90.27	(217)

Water heating fuel, kWh/month

195.12	176.21	191.45	180.72	185.31	169.28	162.56	178.40	178.10	185.90	183.17	188.90

$\sum(219a)1...12 =$ 2175.11 (219)

Annual totals

Space heating fuel - main system 1	2448.59	
Water heating fuel	2175.11	

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	350.13	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 5048.83	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2448.59	x	3.48	x 0.01 =	85.21	(240)
Water heating	2175.11	x	3.48	x 0.01 =	75.69	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	350.13	x	13.19	x 0.01 =	46.18	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		336.98	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.12	(257)
SAP value	84.38	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2448.59	x	0.22	=	528.90	(261)
Water heating	2175.11	x	0.22	=	469.82	(264)
Space and water heating			(261) + (262) + (263) + (264) =		998.72	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	350.13	x	0.52	=	181.72	(268)
Total CO_2, kg/year			(265)...(271) =		1219.36	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		14.98	(273)
EI value					87.08	
EI rating (section 14)					87	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2448.59	x	1.22	=	2987.28	(261)
Water heating	2175.11	x	1.22	=	2653.63	(264)

Space and water heating					(261) + (262) + (263) + (264) =	5640.91	(265)
Pumps and fans	75.00	x	3.07	=		230.25	(267)
Electricity for lighting	350.13	x	3.07	=		1074.89	(268)
Primary energy kWh/year						6946.05	(272)
Dwelling primary energy rate kWh/m2/year						85.31	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	07/03/2016
Address	Unit 3 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.42 (1a)	x	2.40 (2a)	=	195.41 (3a)	
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.42 (4)					
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		195.41 (5)	

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		3	x 10 =	30 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.35 (18)
Number of sides on which the dwelling is sheltered		3 (19)
Shelter factor	1 - [0.075 x (19)] =	0.78 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.27 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2													
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4													
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m													
	0.35	0.34	0.34	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		N/A (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.68	x	1.33	=	26.09			(27)
Ground floor			81.42	x	0.15	=	12.21			(28a)
External wall			20.88	x	0.28	=	5.85			(29a)
Party wall			59.28	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			121.98							(31)

Fabric heat loss, W/K = ∑(A × U)   (26)...(30) + (32) = 44.15   (33)

Heat capacity Cm = ∑(A x κ)   (28)...(30) + (32) + (32a)...(32e) = N/A   (34)

Thermal mass parameter (TMP) in kJ/m²K   250.00   (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K   14.37   (36)

Total fabric heat loss   (33) + (36) = 58.52   (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	36.18	36.02	35.87	35.17	35.04	34.43	34.43	34.31	34.66	35.04	35.31	35.58	(38)
Heat transfer coefficient, W/K (37)m + (38)m	94.69	94.54	94.39	93.69	93.56	92.94	92.94	92.83	93.18	93.56	93.82	94.10	

Average = ∑(39)1...12/12 = 93.69   (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.16	1.16	1.16	1.15	1.15	1.14	1.14	1.14	1.14	1.15	1.15	1.16	

Average = ∑(40)1...12/12 = 1.15   (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N   2.49   (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   93.32   (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	102.65	98.92	95.19	91.45	87.72	83.99	83.99	87.72	91.45	95.19	98.92	102.65	

∑(44)1...12 = 1119.84   (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	152.23	133.14	137.39	119.78	114.93	99.18	91.90	105.46	106.72	124.37	135.76	147.43	

∑(45)1...12 = 1468.28   (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	22.83	19.97	20.61	17.97	17.24	14.88	13.79	15.82	16.01	18.66	20.36	22.11	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel   125.00   (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)   0.01   (51)

Volume factor from Table 2a   0.99   (52)

Temperature factor from Table 2b   0.54   (53)

Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)   0.77   (54)

Enter (50) or (54) in (55)   0.77   (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

| 23.84 | 21.53 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | (57) |

Primary circuit loss for each month from Table 3

| 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss for each month from Table 3a, 3b or 3c

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (61) |

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

| 199.33 | 175.68 | 184.49 | 165.36 | 162.03 | 144.76 | 139.00 | 152.56 | 152.30 | 171.47 | 181.34 | 194.53 | (62) |

Solar DHW input calculated using Appendix G or Appendix H

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (63) |

Flue gas heat recovery system 1 input (Appendix G1)

| -20.92 | -16.10 | -13.68 | -8.70 | -6.71 | -5.44 | -5.21 | -5.73 | -5.73 | -9.29 | -15.84 | -21.41 | (63) |

Output from water heater for each month (kWh/month) (62)m + (63)m

| 178.40 | 159.58 | 170.81 | 156.66 | 155.33 | 139.32 | 133.79 | 146.83 | 146.57 | 162.18 | 165.50 | 173.12 |

∑(64)1...12 = 1888.08 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45) + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

| 88.30 | 78.30 | 83.36 | 76.29 | 75.89 | 69.44 | 68.24 | 72.74 | 71.95 | 79.03 | 81.60 | 86.70 | (65) |

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Metabolic gains (Table 5)

| 149.36 | 149.36 | 149.36 | 149.36 | 149.36 | 149.36 | 149.36 | 149.36 | 149.36 | 149.36 | 149.36 | 149.36 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| 49.56 | 44.02 | 35.80 | 27.10 | 20.26 | 17.10 | 18.48 | 24.02 | 32.24 | 40.94 | 47.79 | 50.94 | (67) |

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| 331.91 | 335.36 | 326.68 | 308.20 | 284.88 | 262.96 | 248.31 | 244.87 | 253.55 | 272.02 | 295.35 | 317.27 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | (69) |

Pump and fan gains (Table 5a)

| 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | (70) |

Losses e.g. evaporation (Table 5)

| -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | (71) |

Water heating gains (Table 5)

| 118.68 | 116.52 | 112.04 | 105.96 | 102.01 | 96.44 | 91.72 | 97.77 | 99.93 | 106.23 | 113.34 | 116.53 | (72) |

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| 605.37 | 601.11 | 579.74 | 546.47 | 512.36 | 481.72 | 463.72 | 471.88 | 490.93 | 524.40 | 561.68 | 589.95 | (73) |

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.92	x	36.79	x 0.9 x	0.76	x	0.70	=	107.43	(79)
South	0.77	x	5.28	x	46.75	x 0.9 x	0.76	x	0.70	=	91.01	(78)
East	0.77	x	3.60	x	19.64	x 0.9 x	0.76	x	0.70	=	26.07	(76)
West	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(80)

Solar gains in watts ∑(74)m...(82)m

| 245.36 | 423.84 | 591.41 | 745.29 | 841.29 | 836.76 | 806.18 | 735.18 | 645.26 | 471.93 | 295.06 | 209.17 | (83) |

Total gains - internal and solar (73)m + (83)m

| 850.73 | 1024.95 | 1171.15 | 1291.76 | 1353.65 | 1318.48 | 1269.90 | 1207.06 | 1136.19 | 996.33 | 856.75 | 799.12 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) — **21.00** (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.89	0.78	0.62	0.45	0.32	0.35	0.55	0.82	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.14	20.37	20.63	20.85	20.96	20.99	21.00	21.00	20.98	20.82	20.44	20.08	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.95	19.95	19.95	19.96	19.96	19.97	19.97	19.97	19.96	19.96	19.96	19.96	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.97	0.94	0.86	0.73	0.56	0.38	0.25	0.27	0.47	0.78	0.94	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.85	19.17	19.52	19.80	19.93	19.96	19.97	19.97	19.95	19.79	19.28	18.77	(90)

Living area fraction — Living area ÷ (4) = **0.31** (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.24	19.54	19.86	20.12	20.24	20.28	20.28	20.28	20.27	20.10	19.64	19.17	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.09	19.39	19.71	19.97	20.09	20.13	20.13	20.13	20.12	19.95	19.49	19.02	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.93	0.86	0.73	0.56	0.39	0.26	0.29	0.49	0.78	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	821.36	951.17	1004.91	944.77	762.94	511.08	328.01	346.02	552.47	772.94	798.69	777.36	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1400.56	1369.56	1246.64	1037.37	785.07	513.76	328.27	346.47	560.63	875.16	1162.00	1394.89	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	430.93	281.16	179.85	66.67	16.46	0.00	0.00	0.00	0.00	76.05	261.58	459.45	

∑(98)1...5, 10...12 = **1772.14** (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) **21.77** (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)	0.00	(201)
Fraction of space heat from main system(s)	1 - (201) = 1.00	(202)
Fraction of space heat from main system 2	0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] = 1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) = 0.00	(205)
Efficiency of main system 1 (%)	93.00	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	463.36	302.32	193.39	71.69	17.70	0.00	0.00	0.00	0.00	81.77	281.27	494.03	

∑(211)1...5, 10...12 = **1905.52** (211)

Water heating

Efficiency of water heater

| 89.59 | 88.82 | 87.46 | 85.23 | 83.22 | 82.30 | 82.30 | 82.30 | 82.30 | 85.44 | 88.54 | 89.80 | (217) |

Water heating fuel, kWh/month

199.13	179.67	195.29	183.81	186.65	169.28	162.56	178.40	178.10	189.82	186.92	192.77

$\sum(219a)1...12 =$ | 2202.42 | (219)

Annual totals

Space heating fuel - main system 1	1905.52	
Water heating fuel	2202.42	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	350.13	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 4533.07	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1905.52	x	3.48	x 0.01 =	66.31	(240)
Water heating	2202.42	x	3.48	x 0.01 =	76.64	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	350.13	x	13.19	x 0.01 =	46.18	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		319.03	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.06	(257)
SAP value	85.21	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	1905.52	x	0.22	=	411.59	(261)
Water heating	2202.42	x	0.22	=	475.72	(264)
Space and water heating			(261) + (262) + (263) + (264) =		887.32	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	350.13	x	0.52	=	181.72	(268)
Total CO_2, kg/year			(265)...(271) =		1107.96	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		13.61	(273)
EI value					88.26	
EI rating (section 14)					88	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1905.52	x	1.22	=	2324.74	(261)
Water heating	2202.42	x	1.22	=	2686.96	(264)

Space and water heating						(261) + (262) + (263) + (264) =	5011.70	(265)
Pumps and fans		75.00	x	3.07		=	230.25	(267)
Electricity for lighting		350.13	x	3.07		=	1074.89	(268)
Primary energy kWh/year							6316.83	(272)
Dwelling primary energy rate kWh/m2/year							77.58	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	07/03/2016
Address	Unit 3 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.42 (1a)	x	2.40 (2a)	=	195.41	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.42 (4)					
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		195.41	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.35	0.34	0.34	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.68 x	1.33 =	26.09			(27)
Ground floor			81.42 x	0.15 =	12.21			(28a)
External wall			20.88 x	0.16 =	3.34			(29a)
Party wall			59.28 x	0.00 =	0.00			(32)

Total area of external elements ∑A, m²	121.98	(31)
Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) = 41.64	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) = N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	14.37	(36)
Total fabric heat loss	(33) + (36) = 56.01	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	36.18	36.02	35.87	35.17	35.04	34.43	34.43	34.31	34.66	35.04	35.31	35.58	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	92.19	92.04	91.89	91.18	91.05	90.44	90.44	90.32	90.67	91.05	91.32	91.59	

Average = ∑(39)1...12/12 = 91.18   (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.13	1.13	1.13	1.12	1.12	1.11	1.11	1.11	1.11	1.12	1.12	1.12	

Average = ∑(40)1...12/12 = 1.12   (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)													
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.49	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.32	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	102.65	98.92	95.19	91.45	87.72	83.99	83.99	87.72	91.45	95.19	98.92	102.65	

∑(44)1...12 = 1119.84   (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	152.23	133.14	137.39	119.78	114.93	99.18	91.90	105.46	106.72	124.37	135.76	147.43	

∑(45)1...12 = 1468.28   (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m													
	22.83	19.97	20.61	17.97	17.24	14.88	13.79	15.82	16.01	18.66	20.36	22.11	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	125.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	0.99	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.77	(54)
Enter (50) or (54) in (55)	0.77	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m													
	23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

NHER

| 23.84 | 21.53 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | (57) |

Primary circuit loss for each month from Table 3

| 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss for each month from Table 3a, 3b or 3c

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (61) |

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

| 199.33 | 175.68 | 184.49 | 165.36 | 162.03 | 144.76 | 139.00 | 152.56 | 152.30 | 171.47 | 181.34 | 194.53 | (62) |

Solar DHW input calculated using Appendix G or Appendix H

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (63) |

Flue gas heat recovery system 1 input (Appendix G1)

| -22.96 | -17.57 | -15.04 | -9.41 | -6.89 | -5.44 | -5.21 | -5.73 | -5.73 | -10.35 | -17.42 | -23.44 | (63) |

Output from water heater for each month (kWh/month) (62)m + (63)m

| 176.36 | 158.11 | 169.45 | 155.95 | 155.14 | 139.32 | 133.79 | 146.83 | 146.57 | 161.11 | 163.92 | 171.09 | |

∑(64)1...12 = | 1877.64 | (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45) + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

| 88.30 | 78.30 | 83.36 | 76.29 | 75.89 | 69.44 | 68.24 | 72.74 | 71.95 | 79.03 | 81.60 | 86.70 | (65) |

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Metabolic gains (Table 5)

| 124.46 | 124.46 | 124.46 | 124.46 | 124.46 | 124.46 | 124.46 | 124.46 | 124.46 | 124.46 | 124.46 | 124.46 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| 19.83 | 17.61 | 14.32 | 10.84 | 8.10 | 6.84 | 7.39 | 9.61 | 12.90 | 16.38 | 19.11 | 20.38 | (67) |

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| 222.38 | 224.69 | 218.88 | 206.50 | 190.87 | 176.18 | 166.37 | 164.06 | 169.88 | 182.26 | 197.88 | 212.57 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| 35.45 | 35.45 | 35.45 | 35.45 | 35.45 | 35.45 | 35.45 | 35.45 | 35.45 | 35.45 | 35.45 | 35.45 | (69) |

Pump and fan gains (Table 5a)

| 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | (70) |

Losses e.g. evaporation (Table 5)

| -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | (71) |

Water heating gains (Table 5)

| 118.68 | 116.52 | 112.04 | 105.96 | 102.01 | 96.44 | 91.72 | 97.77 | 99.93 | 106.23 | 113.34 | 116.53 | (72) |

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| 424.22 | 422.16 | 408.58 | 386.63 | 364.32 | 342.81 | 328.82 | 334.78 | 346.04 | 368.20 | 393.68 | 412.82 | (73) |

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.92	x	36.79	x 0.9 x	0.76	x	0.70	=	107.43	(79)
South	0.77	x	5.28	x	46.75	x 0.9 x	0.76	x	0.70	=	91.01	(78)
East	0.77	x	3.60	x	19.64	x 0.9 x	0.76	x	0.70	=	26.07	(76)
West	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(80)

Solar gains in watts ∑(74)m...(82)m

| 245.36 | 423.84 | 591.41 | 745.29 | 841.29 | 836.76 | 806.18 | 735.18 | 645.26 | 471.93 | 295.06 | 209.17 | (83) |

Total gains - internal and solar (73)m + (83)m

| 669.59 | 846.00 | 999.99 | 1131.92 | 1205.61 | 1179.57 | 1134.99 | 1069.97 | 991.30 | 840.13 | 688.74 | 621.98 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)   **21.00** (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.97	0.93	0.83	0.66	0.48	0.35	0.39	0.61	0.88	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.99	20.24	20.53	20.80	20.95	20.99	21.00	21.00	20.97	20.76	20.31	19.93	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.97	19.98	19.98	19.98	19.99	19.99	19.99	19.99	19.99	19.99	19.98	19.98	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.97	0.91	0.79	0.60	0.41	0.27	0.30	0.53	0.84	0.97	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.65	19.01	19.42	19.78	19.94	19.99	19.99	19.99	19.97	19.74	19.12	18.57	(90)

Living area fraction   Living area ÷ (4) = **0.31** (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.06	19.39	19.76	20.09	20.25	20.29	20.30	20.30	20.28	20.05	19.49	18.99	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.91	19.24	19.61	19.94	20.10	20.14	20.15	20.15	20.13	19.90	19.34	18.84	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.96	0.90	0.78	0.61	0.42	0.28	0.32	0.54	0.84	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	659.83	812.22	903.27	887.84	735.92	497.87	320.64	338.06	534.89	706.10	665.43	615.37	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1346.57	1319.39	1204.82	1006.88	764.59	501.35	320.97	338.66	546.56	846.88	1117.29	1340.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	510.94	340.82	224.35	85.71	21.33	0.00	0.00	0.00	0.00	104.74	325.34	539.81	

∑(98)1...5, 10...12 = **2153.04** (98)

Space heating requirement kWh/m²/year   (98) ÷ (4) **26.44** (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)   **0.00** (201)

Fraction of space heat from main system(s)   1 - (201) = **1.00** (202)

Fraction of space heat from main system 2   **0.00** (202)

Fraction of total space heat from main system 1   (202) x [1- (203)] = **1.00** (204)

Fraction of total space heat from main system 2   (202) x (203) = **0.00** (205)

Efficiency of main system 1 (%)   **93.00** (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	549.39	366.47	241.24	92.16	22.94	0.00	0.00	0.00	0.00	112.63	349.83	580.44

∑(211)1...5, 10...12 = **2315.10** (211)

Water heating

Efficiency of water heater

| 90.00 | 89.32 | 88.07 | 85.80 | 83.46 | 82.30 | 82.30 | 82.30 | 82.30 | 86.21 | 89.12 | 90.18 | (217) |

Water heating fuel, kWh/month

| 195.97 | 177.02 | 192.39 | 181.76 | 185.89 | 169.28 | 162.56 | 178.40 | 178.10 | 186.89 | 183.93 | 189.72 |

$\sum$(219a)1...12 = **2181.91** (219)

Annual totals

Space heating fuel - main system 1	2315.10	
Water heating fuel	2181.91	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	350.13	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 4922.14	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2315.10	x	3.48	x 0.01 =	80.57	(240)
Water heating	2181.91	x	3.48	x 0.01 =	75.93	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	350.13	x	13.19	x 0.01 =	46.18	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	332.57	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.10	(257)
SAP value	84.59	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2315.10	x	0.22	=	500.06	(261)
Water heating	2181.91	x	0.22	=	471.29	(264)
Space and water heating			(261) + (262) + (263) + (264) =		971.35	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	350.13	x	0.52	=	181.72	(268)
Total CO_2, kg/year			(265)...(271) =		1191.99	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		14.64	(273)
EI value					87.37	
EI rating (section 14)					87	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2315.10	x	1.22	=	2824.42	(261)
Water heating	2181.91	x	1.22	=	2661.93	(264)

Space and water heating				(261) + (262) + (263) + (264) =	5486.35	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	350.13	x	3.07	=	1074.89	(268)
Primary energy kWh/year					6791.49	(272)
Dwelling primary energy rate kWh/m2/year					83.41	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	07/03/2016
Address	Unit 3 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.42	(1a) x	2.40	(2a) =	195.41	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.42	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		195.41	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2													
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4													
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m													
	0.35	0.34	0.34	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.68 x	1.33 =	26.09			(27)
Ground floor			81.42 x	0.15 =	12.21			(28a)
External wall			20.88 x	0.16 =	3.34			(29a)
Party wall			59.28 x	0.00 =	0.00			(32)

Total area of external elements ∑A, m²	121.98	(31)
Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) = 41.64	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) = N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	14.37	(36)
Total fabric heat loss	(33) + (36) = 56.01	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	36.18	36.02	35.87	35.17	35.04	34.43	34.43	34.31	34.66	35.04	35.31	35.58	(38)
Heat transfer coefficient, W/K (37)m + (38)m	92.19	92.04	91.89	91.18	91.05	90.44	90.44	90.32	90.67	91.05	91.32	91.59	(39)

Average = ∑(39)1...12/12 = 91.18 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.13	1.13	1.13	1.12	1.12	1.11	1.11	1.11	1.11	1.12	1.12	1.12	

Average = ∑(40)1...12/12 = 1.12 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.49	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.32	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	102.65	98.92	95.19	91.45	87.72	83.99	83.99	87.72	91.45	95.19	98.92	102.65	

∑(44)1...12 = 1119.84 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	152.23	133.14	137.39	119.78	114.93	99.18	91.90	105.46	106.72	124.37	135.76	147.43	

∑(45)1...12 = 1468.28 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	22.83	19.97	20.61	17.97	17.24	14.88	13.79	15.82	16.01	18.66	20.36	22.11	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	125.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	0.99	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.77	(54)
Enter (50) or (54) in (55)	0.77	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

| 23.84 | 21.53 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | (57) |

Primary circuit loss for each month from Table 3

| 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss for each month from Table 3a, 3b or 3c

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (61) |

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

| 199.33 | 175.68 | 184.49 | 165.36 | 162.03 | 144.76 | 139.00 | 152.56 | 152.30 | 171.47 | 181.34 | 194.53 | (62) |

Solar DHW input calculated using Appendix G or Appendix H

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (63) |

Flue gas heat recovery system 1 input (Appendix G1)

| -20.36 | -15.64 | -13.09 | -8.39 | -6.60 | -5.44 | -5.21 | -5.73 | -5.73 | -8.97 | -15.42 | -20.84 | (63) |

Output from water heater for each month (kWh/month) (62)m + (63)m

| 178.97 | 160.04 | 171.40 | 156.97 | 155.43 | 139.32 | 133.79 | 146.83 | 146.57 | 162.50 | 165.92 | 173.69 |

∑(64)1...12 = 1891.42 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

| 88.30 | 78.30 | 83.36 | 76.29 | 75.89 | 69.44 | 68.24 | 72.74 | 71.95 | 79.03 | 81.60 | 86.70 | (65) |

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	149.36	149.36	149.36	149.36	149.36	149.36	149.36	149.36	149.36	149.36	149.36	149.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| 49.56 | 44.02 | 35.80 | 27.10 | 20.26 | 17.10 | 18.48 | 24.02 | 32.24 | 40.94 | 47.79 | 50.94 | (67) |

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| 331.91 | 335.36 | 326.68 | 308.20 | 284.88 | 262.96 | 248.31 | 244.87 | 253.55 | 272.02 | 295.35 | 317.27 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | 52.42 | (69) |

Pump and fan gains (Table 5a)

| 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | (70) |

Losses e.g. evaporation (Table 5)

| -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | -99.57 | (71) |

Water heating gains (Table 5)

| 118.68 | 116.52 | 112.04 | 105.96 | 102.01 | 96.44 | 91.72 | 97.77 | 99.93 | 106.23 | 113.34 | 116.53 | (72) |

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| 605.37 | 601.11 | 579.74 | 546.47 | 512.36 | 481.72 | 463.72 | 471.88 | 490.93 | 524.40 | 561.68 | 589.95 | (73) |

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.92	x	36.79	x 0.9 x	0.76	x	0.70	=	107.43	(79)
South	0.77	x	5.28	x	46.75	x 0.9 x	0.76	x	0.70	=	91.01	(78)
East	0.77	x	3.60	x	19.64	x 0.9 x	0.76	x	0.70	=	26.07	(76)
West	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(80)

Solar gains in watts ∑(74)m...(82)m

| 245.36 | 423.84 | 591.41 | 745.29 | 841.29 | 836.76 | 806.18 | 735.18 | 645.26 | 471.93 | 295.06 | 209.17 | (83) |

Total gains - internal and solar (73)m + (83)m

| 850.73 | 1024.95 | 1171.15 | 1291.76 | 1353.65 | 1318.48 | 1269.90 | 1207.06 | 1136.19 | 996.33 | 856.75 | 799.12 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) **21.00** (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	0.98	0.95	0.88	0.76	0.60	0.44	0.31	0.34	0.54	0.82	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.18	20.41	20.66	20.87	20.97	20.99	21.00	21.00	20.98	20.84	20.47	20.13	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	19.97	19.98	19.98	19.98	19.99	19.99	19.99	19.99	19.99	19.99	19.98	19.98	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	0.97	0.93	0.86	0.72	0.54	0.37	0.24	0.27	0.46	0.77	0.94	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	18.93	19.25	19.58	19.85	19.96	19.99	19.99	19.99	19.98	19.83	19.35	18.85	(90)

Living area fraction Living area ÷ (4) = **0.31** (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	19.31	19.60	19.91	20.16	20.26	20.30	20.30	20.30	20.29	20.14	19.69	19.24	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	19.16	19.45	19.76	20.01	20.11	20.15	20.15	20.15	20.14	19.99	19.54	19.09	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.96	0.93	0.85	0.72	0.55	0.38	0.25	0.28	0.48	0.77	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	820.52	948.39	998.09	931.98	747.78	499.46	320.80	338.37	540.72	764.32	796.53	776.80	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	1369.81	1339.21	1218.47	1012.95	766.17	501.57	321.00	338.71	547.36	855.05	1136.25	1364.07	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	408.68	262.63	163.96	58.30	13.69	0.00	0.00	0.00	0.00	67.50	244.60	436.93	

∑(98)1...5, 10...12 = **1656.28** (98)

Space heating requirement kWh/m²/year (98) ÷ (4) **20.34** (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.00	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month													
	439.44	282.40	176.31	62.69	14.72	0.00	0.00	0.00	0.00	72.58	263.01	469.82	

∑(211)1...5, 10...12 = **1780.95** (211)

Water heating

Efficiency of water heater

| 89.46 | 88.64 | 87.21 | 84.95 | 83.07 | 82.30 | 82.30 | 82.30 | 82.30 | 85.18 | 88.36 | 89.68 | (217) |

Water heating fuel, kWh/month

| 200.06 | 180.56 | 196.55 | 184.78 | 187.10 | 169.28 | 162.56 | 178.40 | 178.10 | 190.78 | 187.78 | 193.67 |

$\sum(219a)1...12 =$ | 2209.62 | (219)

Annual totals

Space heating fuel - main system 1	1780.95	
Water heating fuel	2209.62	

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	350.13	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4415.70	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1780.95	x	3.48	x 0.01 =	61.98	(240)
Water heating	2209.62	x	3.48	x 0.01 =	76.89	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	350.13	x	13.19	x 0.01 =	46.18	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		314.95	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.05	(257)
SAP value	85.40	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO$_2$/kWh		Emissions kg CO$_2$/year	
Space heating - main system 1	1780.95	x	0.22	=	384.69	(261)
Water heating	2209.62	x	0.22	=	477.28	(264)
Space and water heating			(261) + (262) + (263) + (264) =		861.96	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	350.13	x	0.52	=	181.72	(268)
Total CO$_2$, kg/year			(265)...(271) =		1082.60	(272)
Dwelling CO$_2$ emission rate			(272) ÷ (4) =		13.30	(273)
EI value					88.52	
EI rating (section 14)					89	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1780.95	x	1.22	=	2172.76	(261)
Water heating	2209.62	x	1.22	=	2695.74	(264)

Space and water heating							(261) + (262) + (263) + (264) =	4868.50	(265)
Pumps and fans	75.00	x	3.07		=			230.25	(267)
Electricity for lighting	350.13	x	3.07		=			1074.89	(268)
Primary energy kWh/year								6173.64	(272)
Dwelling primary energy rate kWh/m2/year								75.82	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 3 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.42	(1a) x	2.40	(2a) =	195.41	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.42	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		195.41	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.35	0.34	0.34	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.68	x	1.33	=	26.09			(27)
Ground floor			81.42	x	0.15	=	12.21			(28a)
External wall			20.88	x	0.16	=	3.34			(29a)
Party wall			59.28	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			121.98							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	41.64	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.37	(36)
Total fabric heat loss	(33) + (36) =	56.01	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	36.18	36.02	35.87	35.17	35.04	34.43	34.43	34.31	34.66	35.04	35.31	35.58	(38)
Heat transfer coefficient, W/K (37)m + (38)m	92.19	92.04	91.89	91.18	91.05	90.44	90.44	90.32	90.67	91.05	91.32	91.59	(39)

Average = ∑(39)1...12/12 = 91.18 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.13	1.13	1.13	1.12	1.12	1.11	1.11	1.11	1.11	1.12	1.12	1.12	(40)

Average = ∑(40)1...12/12 = 1.12 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.49	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.32	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	102.65	98.92	95.19	91.45	87.72	83.99	83.99	87.72	91.45	95.19	98.92	102.65	(44)

∑(44)1...12 = 1119.84 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	152.23	133.14	137.39	119.78	114.93	99.18	91.90	105.46	106.72	124.37	135.76	147.43	(45)

∑(45)1...12 = 1468.28 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	22.83	19.97	20.61	17.97	17.24	14.88	13.79	15.82	16.01	18.66	20.36	22.11	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	125.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	0.99	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.77	(54)
Enter (50) or (54) in (55)	0.77	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

NHER

23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

199.33	175.68	184.49	165.36	162.03	144.76	139.00	152.56	152.30	171.47	181.34	194.53	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

199.33	175.68	184.49	165.36	162.03	144.76	139.00	152.56	152.30	171.47	181.34	194.53

∑(64)1...12 = 2022.84 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

88.30	78.30	83.36	76.29	75.89	69.44	68.24	72.74	71.95	79.03	81.60	86.70	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	124.46	124.46	124.46	124.46	124.46	124.46	124.46	124.46	124.46	124.46	124.46	124.46	(66)
Lighting gains (Appendix L, eq L9 or L9a)	19.83	17.61	14.32	10.84	8.10	6.84	7.39	9.61	12.90	16.38	19.11	20.38	(67)
Appliance gains (Appendix L, eq L13 or L13a)	222.38	224.69	218.88	206.50	190.87	176.18	166.37	164.06	169.88	182.26	197.88	212.57	(68)
Cooking gains (Appendix L, eq L15 or L15a)	35.45	35.45	35.45	35.45	35.45	35.45	35.45	35.45	35.45	35.45	35.45	35.45	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	(71)
Water heating gains (Table 5)	118.68	116.52	112.04	105.96	102.01	96.44	91.72	97.77	99.93	106.23	113.34	116.53	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	424.22	422.16	408.58	386.63	364.32	342.81	328.82	334.78	346.04	368.20	393.68	412.82	(73)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.92	x	36.79	x 0.9 x	0.76	x	0.70	=	107.43	(79)
South	0.77	x	5.28	x	46.75	x 0.9 x	0.76	x	0.70	=	91.01	(78)
East	0.77	x	3.60	x	19.64	x 0.9 x	0.76	x	0.70	=	26.07	(76)
West	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(80)

Solar gains in watts ∑(74)m...(82)m

245.36	423.84	591.41	745.29	841.29	836.76	806.18	735.18	645.26	471.93	295.06	209.17	(83)

Total gains - internal and solar (73)m + (83)m

669.59	846.00	999.99	1131.92	1205.61	1179.57	1134.99	1069.97	991.30	840.13	688.74	621.98	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) | 21.00 | (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains for living area n1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.99	0.97	0.93	0.83	0.66	0.48	0.35	0.39	0.61	0.88	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.99	20.24	20.53	20.80	20.95	20.99	21.00	21.00	20.97	20.76	20.31	19.93	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.97	19.98	19.98	19.98	19.99	19.99	19.99	19.99	19.99	19.99	19.98	19.98	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.91	0.79	0.60	0.41	0.27	0.30	0.53	0.84	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.65	19.01	19.42	19.78	19.94	19.99	19.99	19.99	19.97	19.74	19.12	18.57	(90)

Living area fraction   Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.06	19.39	19.76	20.09	20.25	20.29	20.30	20.30	20.28	20.05	19.49	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.06	19.39	19.76	20.09	20.25	20.29	20.30	20.30	20.28	20.05	19.49	18.99	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, ηm

0.99	0.96	0.91	0.79	0.62	0.43	0.29	0.33	0.55	0.85	0.97	0.99	(94)

Useful gains, ηmGm, W (94)m x (84)m

660.24	813.51	906.64	895.08	747.04	510.89	334.11	351.45	546.94	711.60	666.50	615.65	(95)

Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1360.40	1333.19	1218.60	1020.55	778.25	514.92	334.54	352.21	560.17	860.54	1130.99	1354.66	(97)

Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

520.92	349.23	232.10	90.34	23.22	0.00	0.00	0.00	0.00	110.81	334.43	549.82

∑(98)1...5, 10...12 = 2210.87 (98)

Space heating requirement kWh/m²/year   (98) ÷ (4) 27.15 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)   0.00 (201)

Fraction of space heat from main system(s)   1 - (201) = 1.00 (202)

Fraction of space heat from main system 2   0.00 (202)

Fraction of total space heat from main system 1   (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2   (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)   249.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Space heating fuel (main system 1), kWh/month

208.45	139.75	92.88	36.15	9.29	0.00	0.00	0.00	0.00	44.34	133.83	220.02

∑(211)1...5, 10...12 = 884.70 (211)

Water heating

Efficiency of water heater

175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	(217)

Water heating fuel, kWh/month

| 113.84 | 100.33 | 105.36 | 94.44 | 92.54 | 82.67 | 79.38 | 87.13 | 86.98 | 97.93 | 103.56 | 111.09 |

$\sum(219a)1...12 =$	1155.25	(219)

Annual totals

Space heating fuel - main system 1	884.70	
Water heating fuel	1155.25	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
Total electricity for the above, kWh/year	30.00	(231)
Electricity for lighting (Appendix L)	350.13	(232)
Energy saving/generation technologies		
electricity generated by PV (Appendix M)	-760.49	(233)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 1659.58	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	884.70	x	13.19	x 0.01 =	116.69	(240)
Water heating	1155.25	x	13.19	x 0.01 =	152.38	(247)
Pumps and fans	30.00	x	13.19	x 0.01 =	3.96	(249)
Electricity for lighting	350.13	x	13.19	x 0.01 =	46.18	(250)
Additional standing charges					0.00	(251)
Energy saving/generation technologies						
pv savings	-760.49	x	13.19	x 0.01 =	0.00	(252)
Total energy cost			(240)...(242) + (245)...(254) =		319.21	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.06	(257)
SAP value	85.21	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	884.70	x	0.52	=	459.16	(261)
Water heating	1155.25	x	0.52	=	599.57	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1058.73	(265)
Pumps and fans	30.00	x	0.52	=	15.57	(267)
Electricity for lighting	350.13	x	0.52	=	181.72	(268)
Energy saving/generation technologies						
pv savings	-760.49	x	0.52	=	-394.70	(269)
Total CO_2, kg/year			(265)...(271) =		861.32	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		10.58	(273)
EI value					90.87	
EI rating (section 14)					91	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	884.70	x	3.07	=	2716.03	(261)
Water heating	1155.25	x	3.07	=	3546.61	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6262.64	(265)
Pumps and fans	30.00	x	3.07	=	92.10	(267)
Electricity for lighting	350.13	x	3.07	=	1074.89	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-760.49	x	3.07	=	-2334.71	(269)
Primary energy kWh/year					5094.91	(272)
Dwelling primary energy rate kWh/m2/year					62.58	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 3 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.42	(1a) x	2.40	(2a) =	195.41	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.42	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		195.41	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.35	0.34	0.34	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft													
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)													
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.68	x	1.33	=	26.09			(27)
Ground floor			81.42	x	0.15	=	12.21			(28a)
External wall			20.88	x	0.16	=	3.34			(29a)
Party wall			59.28	x	0.00	=	0.00			(32)

Total area of external elements ∑A, m² | 121.98 | (31)

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = | 41.64 | (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = | N/A | (34)

Thermal mass parameter (TMP) in kJ/m²K | 250.00 | (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K | 14.37 | (36)

Total fabric heat loss (33) + (36) = | 56.01 | (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	36.18	36.02	35.87	35.17	35.04	34.43	34.43	34.31	34.66	35.04	35.31	35.58	(38)
Heat transfer coefficient, W/K (37)m + (38)m	92.19	92.04	91.89	91.18	91.05	90.44	90.44	90.32	90.67	91.05	91.32	91.59	

Average = ∑(39)1...12/12 = | 91.18 | (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.13	1.13	1.13	1.12	1.12	1.11	1.11	1.11	1.11	1.12	1.12	1.12	

Average = ∑(40)1...12/12 = | 1.12 | (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N | 2.49 | (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 93.32 | (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	102.65	98.92	95.19	91.45	87.72	83.99	83.99	87.72	91.45	95.19	98.92	102.65	

∑(44)1...12 = | 1119.84 | (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	152.23	133.14	137.39	119.78	114.93	99.18	91.90	105.46	106.72	124.37	135.76	147.43	

∑(45)1...12 = | 1468.28 | (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	22.83	19.97	20.61	17.97	17.24	14.88	13.79	15.82	16.01	18.66	20.36	22.11	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel | 125.00 | (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.01 | (51)

Volume factor from Table 2a | 0.99 | (52)

Temperature factor from Table 2b | 0.54 | (53)

Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) | 0.77 | (54)

Enter (50) or (54) in (55) | 0.77 | (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

NHER

23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

199.33	175.68	184.49	165.36	162.03	144.76	139.00	152.56	152.30	171.47	181.34	194.53	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

199.33	175.68	184.49	165.36	162.03	144.76	139.00	152.56	152.30	171.47	181.34	194.53

$\sum(64)1...12 =$ | 2022.84 | (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

88.30	78.30	83.36	76.29	75.89	69.44	68.24	72.74	71.95	79.03	81.60	86.70	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	149.36	149.36	149.36	149.36	149.36	149.36	149.36	149.36	149.36	149.36	149.36	149.36	(66)
Lighting gains	49.56	44.02	35.80	27.10	20.26	17.10	18.48	24.02	32.24	40.94	47.79	50.94	(67)
Appliance gains	331.91	335.36	326.68	308.20	284.88	262.96	248.31	244.87	253.55	272.02	295.35	317.27	(68)
Cooking gains	52.42	52.42	52.42	52.42	52.42	52.42	52.42	52.42	52.42	52.42	52.42	52.42	(69)
Pump and fan gains	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	-99.57	(71)
Water heating gains	118.68	116.52	112.04	105.96	102.01	96.44	91.72	97.77	99.93	106.23	113.34	116.53	(72)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67)

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)

Pump and fan gains (Table 5a) (70)

Losses e.g. evaporation (Table 5) (71)

Water heating gains (Table 5) (72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

605.37	601.11	579.74	546.47	512.36	481.72	463.72	471.88	490.93	524.40	561.68	589.95	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.92	x	36.79	x 0.9 x	0.76	x	0.70	=	107.43	(79)
South	0.77	x	5.28	x	46.75	x 0.9 x	0.76	x	0.70	=	91.01	(78)
East	0.77	x	3.60	x	19.64	x 0.9 x	0.76	x	0.70	=	26.07	(76)
West	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(80)

Solar gains in watts $\sum(74)m...(82)m$

245.36	423.84	591.41	745.29	841.29	836.76	806.18	735.18	645.26	471.93	295.06	209.17	(83)

Total gains - internal and solar (73)m + (83)m

850.73	1024.95	1171.15	1291.76	1353.65	1318.48	1269.90	1207.06	1136.19	996.33	856.75	799.12	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) | 21.00 | (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	0.98	0.95	0.88	0.76	0.60	0.44	0.31	0.34	0.54	0.82	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.18	20.41	20.66	20.87	20.97	20.99	21.00	21.00	20.98	20.84	20.47	20.13	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	19.97	19.98	19.98	19.98	19.99	19.99	19.99	19.99	19.99	19.99	19.98	19.98	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	0.97	0.93	0.86	0.72	0.54	0.37	0.24	0.27	0.46	0.77	0.94	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	18.93	19.25	19.58	19.85	19.96	19.99	19.99	19.99	19.98	19.83	19.35	18.85	(90)

Living area ÷ (4) = $\boxed{0.31}$ (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	19.31	19.60	19.91	20.16	20.26	20.30	20.30	20.30	20.29	20.14	19.69	19.24	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.31	19.60	19.91	20.16	20.26	20.30	20.30	20.30	20.29	20.14	19.69	19.24	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.97	0.93	0.86	0.73	0.56	0.39	0.26	0.29	0.49	0.77	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	821.65	950.96	1003.24	940.89	759.73	512.69	334.31	351.83	553.41	772.03	798.93	777.66	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	1383.64	1353.02	1232.25	1026.62	779.83	515.14	334.56	352.26	560.96	868.71	1149.95	1377.81	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	418.12	270.18	170.38	61.73	14.95	0.00	0.00	0.00	0.00	71.93	252.73	446.51	

∑(98)1...5, 10...12 = $\boxed{1706.53}$ (98)

Space heating requirement kWh/m²/year (98) ÷ (4) $\boxed{20.96}$ (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) $\boxed{0.00}$ (201)

Fraction of space heat from main system(s) 1 - (201) = $\boxed{1.00}$ (202)

Fraction of space heat from main system 2 $\boxed{0.00}$ (202)

Fraction of total space heat from main system 1 (202) x [1- (203)] = $\boxed{1.00}$ (204)

Fraction of total space heat from main system 2 (202) x (203) = $\boxed{0.00}$ (205)

Efficiency of main system 1 (%) $\boxed{249.90}$ (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month													
	167.31	108.12	68.18	24.70	5.98	0.00	0.00	0.00	0.00	28.78	101.13	178.67	

∑(211)1...5, 10...12 = $\boxed{682.88}$ (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater													
	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	(217)

Water heating fuel, kWh/month

113.84	100.33	105.36	94.44	92.54	82.67	79.38	87.13	86.98	97.93	103.56	111.09

$\sum(219a)1...12 =$ 1155.25   (219)

Annual totals

Space heating fuel - main system 1	682.88	
Water heating fuel	1155.25	

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
Total electricity for the above, kWh/year	30.00	(231)
Electricity for lighting (Appendix L)	350.13	(232)

Energy saving/generation technologies

electricity generated by PV (Appendix M)	-760.49	(233)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 1457.77	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	682.88	x	13.19	x 0.01 =	90.07	(240)
Water heating	1155.25	x	13.19	x 0.01 =	152.38	(247)
Pumps and fans	30.00	x	13.19	x 0.01 =	3.96	(249)
Electricity for lighting	350.13	x	13.19	x 0.01 =	46.18	(250)
Additional standing charges					0.00	(251)
Energy saving/generation technologies						
pv savings	-760.49	x	13.19	x 0.01 =	0.00	(252)
Total energy cost			(240)...(242) + (245)...(254) =		292.59	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	0.97	(257)
SAP value	86.44	
SAP rating (section 13)	86	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
Space heating - main system 1	682.88	x	0.52	=	354.42	(261)
Water heating	1155.25	x	0.52	=	599.57	(264)
Space and water heating			(261) + (262) + (263) + (264) =		953.99	(265)
Pumps and fans	30.00	x	0.52	=	15.57	(267)
Electricity for lighting	350.13	x	0.52	=	181.72	(268)
Energy saving/generation technologies						
pv savings	-760.49	x	0.52	=	-394.70	(269)
Total CO₂, kg/year			(265)...(271) =		756.58	(272)
Dwelling CO₂ emission rate			(272) ÷ (4) =		9.29	(273)
EI value					91.98	
EI rating (section 14)					92	(274)
EI band					A	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	682.88	x	3.07	=	2096.46	(261)
Water heating	1155.25	x	3.07	=	3546.61	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5643.07	(265)
Pumps and fans	30.00	x	3.07	=	92.10	(267)
Electricity for lighting	350.13	x	3.07	=	1074.89	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-760.49	x	3.07	=	-2334.71	(269)
Primary energy kWh/year					4475.34	(272)
Dwelling primary energy rate kWh/m2/year					54.97	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 5 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		76.16	(1a) x	2.60	(2a) =	198.02	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	76.16	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		198.02	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2													
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4													
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m													
	0.35	0.34	0.33	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48 x	1.33 =	16.55			(27)
External wall			62.92 x	0.28 =	17.62			(29a)
Party wall			30.42 x	0.00 =	0.00			(32)
Roof			76.16 x	0.15 =	11.42			(30)

Total area of external elements ∑A, m²   151.56   (31)

Fabric heat loss, W/K = ∑(A × U)   (26)...(30) + (32) =   45.59   (33)

Heat capacity Cm = ∑(A x κ)   (28)...(30) + (32) + (32a)...(32e) =   N/A   (34)

Thermal mass parameter (TMP) in kJ/m²K   250.00   (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K   9.42   (36)

Total fabric heat loss   (33) + (36) =   55.01   (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	36.61	36.46	36.31	35.61	35.47	34.86	34.86	34.75	35.10	35.47	35.74	36.02	(38)
Heat transfer coefficient, W/K (37)m + (38)m	91.62	91.47	91.32	90.62	90.48	89.87	89.87	89.76	90.11	90.48	90.75	91.03	(39)

Average = ∑(39)1...12/12 =   90.62   (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.20	1.20	1.20	1.19	1.19	1.18	1.18	1.18	1.18	1.19	1.19	1.20	(40)

Average = ∑(40)1...12/12 =   1.19   (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N   2.39   (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   90.87   (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	99.95	96.32	92.68	89.05	85.41	81.78	81.78	85.41	89.05	92.68	96.32	99.95	

∑(44)1...12 =   1090.40   (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	148.23	129.64	133.78	116.63	111.91	96.57	89.49	102.69	103.91	121.10	132.19	143.55	

∑(45)1...12 =   1429.69   (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	22.23	19.45	20.07	17.49	16.79	14.49	13.42	15.40	15.59	18.17	19.83	21.53	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.94	44.33	47.23	43.91	43.53	40.33	41.67	43.53	43.91	47.23	47.50	50.94	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	199.16	173.97	181.01	160.55	155.44	136.90	131.16	146.21	147.83	168.33	179.69	194.49	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Flue gas heat recovery system 1 input (Appendix G1)

-45.43	-37.43	-33.83	-24.29	-15.79	-9.86	-9.17	-10.45	-10.56	-25.89	-36.11	-45.63	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.73	136.55	147.18	136.26	139.64	127.04	121.99	135.77	137.27	142.44	143.58	148.86

∑(64)1...12 = | 1670.30 | (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

62.02	54.19	56.29	49.76	48.09	42.19	40.17	45.02	45.53	52.07	55.83	60.46	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	119.30	119.30	119.30	119.30	119.30	119.30	119.30	119.30	119.30	119.30	119.30	119.30	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

19.56	17.37	14.13	10.69	7.99	6.75	7.29	9.48	12.72	16.15	18.85	20.10	(67)

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

211.23	213.42	207.90	196.14	181.29	167.34	158.02	155.83	161.36	173.11	187.96	201.91	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

34.93	34.93	34.93	34.93	34.93	34.93	34.93	34.93	34.93	34.93	34.93	34.93	(69)

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)

Losses e.g. evaporation (Table 5)

-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	(71)

Water heating gains (Table 5)

83.36	80.64	75.66	69.11	64.64	58.60	54.00	60.52	63.24	69.99	77.54	81.27	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

375.93	373.22	359.47	337.73	315.72	294.48	281.10	287.62	299.10	321.05	346.14	365.07	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

90.37	176.78	291.12	424.59	520.35	532.67	507.12	435.61	338.59	209.76	112.68	74.31	(83)

Total gains - internal and solar (73)m + (83)m

466.30	549.99	650.59	762.32	836.07	827.15	788.22	723.23	637.69	530.81	458.82	439.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) | 21.00 | (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	1.00	0.99	0.98	0.94	0.83	0.66	0.49	0.55	0.82	0.97	1.00	1.00	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.70	19.87	20.16	20.54	20.82	20.96	20.99	20.99	20.88	20.48	20.02	19.67	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.92	19.92	19.92	19.93	19.93	19.94	19.94	19.94	19.93	19.93	19.93	19.92	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.92	0.78	0.56	0.38	0.43	0.74	0.96	0.99	1.00	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.19	18.44	18.87	19.39	19.76	19.91	19.93	19.93	19.84	19.33	18.66	18.15	(90)

Living area fraction   Living area ÷ (4) = | 0.37 | (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.75	18.97	19.34	19.82	20.15	20.30	20.32	20.32	20.22	19.75	19.16	18.71	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.60	18.82	19.19	19.67	20.00	20.15	20.17	20.17	20.07	19.60	19.01	18.56	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, η_m													
	1.00	0.99	0.97	0.91	0.78	0.58	0.40	0.46	0.75	0.95	0.99	1.00	(94)
Useful gains, $\eta_m G_m$, W (94)m x (84)m													
	464.29	544.64	632.77	697.23	654.80	481.30	318.86	334.11	480.57	506.13	454.77	437.94	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	1309.90	1272.89	1159.27	975.57	751.31	498.53	321.16	338.42	538.19	814.64	1080.67	1306.84	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	629.13	489.39	391.72	200.41	71.81	0.00	0.00	0.00	0.00	229.53	450.65	646.46	

∑(98)1...5, 10...12 = | 3109.10 | (98)

Space heating requirement kWh/m²/year   (98) ÷ (4) | 40.82 | (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)	0.00	(201)
Fraction of space heat from main system(s) 1 - (201) =	1.00	(202)
Fraction of space heat from main system 2	0.00	(202)
Fraction of total space heat from main system 1 (202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2 (202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)	92.90	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month												
	677.22	526.79	421.65	215.72	77.30	0.00	0.00	0.00	0.00	247.08	485.09	695.87

∑(211)1...5, 10...12 = | 3346.71 | (211)

Water heating

Efficiency of water heater

90.73	90.49	89.90	88.53	85.97	82.80	82.80	82.80	82.80	88.75	90.24	90.83	(217)

Water heating fuel, kWh/month

169.44	150.89	163.71	153.91	162.43	153.42	147.33	163.97	165.78	160.49	159.11	163.90

∑(219a)1...12 = | 1914.38 | (219)

Annual totals

Space heating fuel - main system 1	3346.71	
Water heating fuel	1914.38	

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)

Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	345.35	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 5681.44	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3346.71	x	3.48	x 0.01 =	116.47	(240)
Water heating	1914.38	x	3.48	x 0.01 =	66.62	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	345.35	x	13.19	x 0.01 =	45.55	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		358.53	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.24	(257)
SAP value	82.66	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3346.71	x	0.22	=	722.89	(261)
Water heating	1914.38	x	0.22	=	413.51	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1136.40	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	345.35	x	0.52	=	179.24	(268)
Total CO₂, kg/year			(265)...(271) =		1354.56	(272)
Dwelling CO₂ emission rate			(272) ÷ (4) =		17.79	(273)
EI value					85.02	
EI rating (section 14)					85	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3346.71	x	1.22	=	4082.99	(261)
Water heating	1914.38	x	1.22	=	2335.54	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6418.53	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	345.35	x	3.07	=	1060.23	(268)
Primary energy kWh/year					7709.01	(272)
Dwelling primary energy rate kWh/m2/year					101.22	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 5 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		76.16	(1a) x	2.60	(2a) =	198.02	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	76.16	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		198.02	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.35	0.34	0.33	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48 x	1.33 =	16.55			(27)
External wall			62.92 x	0.28 =	17.62			(29a)
Party wall			30.42 x	0.00 =	0.00			(32)
Roof			76.16 x	0.15 =	11.42			(30)

Total area of external elements ∑A, m²	151.56	(31)
Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) =	45.59	(33)
Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	9.42	(36)
Total fabric heat loss (33) + (36) =	55.01	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	36.61	36.46	36.31	35.61	35.47	34.86	34.86	34.75	35.10	35.47	35.74	36.02	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	91.62	91.47	91.32	90.62	90.48	89.87	89.87	89.76	90.11	90.48	90.75	91.03	

Average = ∑(39)1...12/12 = 90.62   (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.20	1.20	1.20	1.19	1.19	1.18	1.18	1.18	1.18	1.19	1.19	1.20	

Average = ∑(40)1...12/12 = 1.19   (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)													
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.39	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	90.87	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	99.95	96.32	92.68	89.05	85.41	81.78	81.78	85.41	89.05	92.68	96.32	99.95	

∑(44)1...12 = 1090.40   (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	148.23	129.64	133.78	116.63	111.91	96.57	89.49	102.69	103.91	121.10	132.19	143.55	

∑(45)1...12 = 1429.69   (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m													
	22.23	19.45	20.07	17.49	16.79	14.49	13.42	15.40	15.59	18.17	19.83	21.53	(46)
Water storage loss calculated for each month (55) x (41)m													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c													
	50.94	44.33	47.23	43.91	43.53	40.33	41.67	43.53	43.91	47.23	47.50	50.94	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m													
	199.16	173.97	181.01	160.55	155.44	136.90	131.16	146.21	147.83	168.33	179.69	194.49	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Flue gas heat recovery system 1 input (Appendix G1)

-40.92	-33.69	-30.27	-20.80	-14.21	-9.86	-9.17	-10.45	-10.56	-22.26	-32.32	-41.20	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

158.25	140.28	150.74	139.74	141.23	127.04	121.99	135.77	137.27	146.07	147.37	153.29

∑(64)1...12 = **1699.02** (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

62.02	54.19	56.29	49.76	48.09	42.19	40.17	45.02	45.53	52.07	55.83	60.46	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	(66)
Lighting gains (Appendix L, eq L9/L9a)	48.89	43.42	35.31	26.73	19.98	16.87	18.23	23.70	31.81	40.38	47.13	50.25	(67)
Appliance gains (Appendix L, eq L13/L13a)	315.27	318.54	310.29	292.74	270.59	249.77	235.86	232.58	240.83	258.38	280.53	301.36	(68)
Cooking gains (Appendix L, eq L15/L15a)	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	(71)
Water heating gains (Table 5)	83.36	80.64	75.66	69.11	64.64	58.60	54.00	60.52	63.24	69.99	77.54	81.27	(72)
Total internal gains (66)m+(67)m+(68)m+(69)m+(70)m+(71)m+(72)m	549.94	545.02	523.69	491.01	457.63	427.66	410.50	419.22	438.29	471.18	507.63	535.29	(73)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

Pump and fan gains (Table 5a)

Losses e.g. evaporation (Table 5)

Water heating gains (Table 5)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

90.37	176.78	291.12	424.59	520.35	532.67	507.12	435.61	338.59	209.76	112.68	74.31	(83)

Total gains - internal and solar (73)m + (83)m

640.30	721.79	814.81	915.60	977.98	960.33	917.63	854.83	776.88	680.94	620.30	609.61	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) **21.00** (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.98	0.96	0.90	0.76	0.58	0.43	0.48	0.73	0.93	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.91	20.07	20.34	20.66	20.88	20.98	21.00	20.99	20.93	20.63	20.20	19.87	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.92	19.92	19.92	19.93	19.93	19.94	19.94	19.94	19.93	19.93	19.93	19.92	(88)

Utilisation factor for gains for rest of dwelling n2,m

NHER

0.99	0.98	0.95	0.86	0.70	0.49	0.33	0.37	0.64	0.91	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.49	18.72	19.11	19.56	19.82	19.92	19.93	19.93	19.88	19.52	18.93	18.44	(90)

Living area fraction   Living area ÷ (4) =   0.37   (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.01	19.22	19.56	19.96	20.21	20.31	20.33	20.32	20.27	19.93	19.40	18.97	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.86	19.07	19.41	19.81	20.06	20.16	20.18	20.17	20.12	19.78	19.25	18.82	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, η_m													
	0.98	0.97	0.94	0.86	0.71	0.51	0.35	0.39	0.66	0.90	0.97	0.99	(94)
Useful gains, $\eta_m G_m$, W (94)m x (84)m													
	630.70	702.52	767.67	787.93	694.30	489.91	320.17	336.67	510.60	613.72	603.39	602.17	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	1334.29	1296.17	1179.34	988.93	756.90	499.73	321.37	338.81	542.43	830.57	1102.44	1330.74	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	523.47	398.93	306.28	144.72	46.57	0.00	0.00	0.00	0.00	161.33	359.32	542.05	

∑(98)1...5, 10...12 =   2482.68   (98)

Space heating requirement kWh/m²/year   (98) ÷ (4)   32.60   (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)   0.00   (201)

Fraction of space heat from main system(s)   1 - (201) =   1.00   (202)

Fraction of space heat from main system 2   0.00   (202)

Fraction of total space heat from main system 1   (202) x [1- (203)] =   1.00   (204)

Fraction of total space heat from main system 2   (202) x (203) =   0.00   (205)

Efficiency of main system 1 (%)   92.90   (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month													
	563.48	429.42	329.69	155.78	50.13	0.00	0.00	0.00	0.00	173.66	386.78	583.48	

∑(211)1...5, 10...12 =   2672.42   (211)

Water heating

Efficiency of water heater

90.34	90.04	89.31	87.65	85.09	82.80	82.80	82.80	82.80	87.81	89.72	90.47	(217)

Water heating fuel, kWh/month

175.16	155.79	168.79	159.44	165.96	153.42	147.33	163.97	165.78	166.35	164.26	169.44	

∑(219a)1...12 =   1955.70   (219)

Annual totals

Space heating fuel - main system 1   2672.42

Water heating fuel   1955.70

Electricity for pumps, fans and electric keep-hot (Table 4f)

     central heating pump or water pump within warm air heating unit   30.00   (230c)

     boiler flue fan   45.00   (230e)

Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		345.35	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5048.48	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2672.42	x	3.48	x 0.01 =	93.00	(240)
Water heating	1955.70	x	3.48	x 0.01 =	68.06	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	345.35	x	13.19	x 0.01 =	45.55	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		336.50	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.17	(257)
SAP value	83.73	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2672.42	x	0.22	=	577.24	(261)
Water heating	1955.70	x	0.22	=	422.43	(264)
Space and water heating			(261) + (262) + (263) + (264) =		999.68	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	345.35	x	0.52	=	179.24	(268)
Total CO_2, kg/year			(265)...(271) =		1217.84	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		15.99	(273)
EI value					86.53	
EI rating (section 14)					87	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2672.42	x	1.22	=	3260.36	(261)
Water heating	1955.70	x	1.22	=	2385.96	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5646.31	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	345.35	x	3.07	=	1060.23	(268)
Primary energy kWh/year					6936.79	(272)
Dwelling primary energy rate kWh/m2/year					91.08	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 6 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		76.16	(1a) x	2.60	(2a) =	198.02	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	76.16	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		198.02	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor — 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor — (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.35	0.34	0.33	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48 x	1.33 =	16.55			(27)
External wall			62.92 x	0.16 =	10.07			(29a)
Party wall			30.42 x	0.00 =	0.00			(32)
Roof			76.16 x	0.15 =	11.42			(30)

Total area of external elements ∑A, m²	151.56	(31)
Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) = 38.04	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) = N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	9.42	(36)
Total fabric heat loss	(33) + (36) = 47.46	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	36.61	36.46	36.31	35.61	35.47	34.86	34.86	34.75	35.10	35.47	35.74	36.02	(38)
Heat transfer coefficient, W/K (37)m + (38)m	84.07	83.92	83.77	83.07	82.93	82.32	82.32	82.21	82.56	82.93	83.20	83.48	

Average = ∑(39)1...12/12 = 83.07 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.10	1.10	1.10	1.09	1.09	1.08	1.08	1.08	1.08	1.09	1.09	1.10	

Average = ∑(40)1...12/12 = 1.09 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.39	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	90.87	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	99.95	96.32	92.68	89.05	85.41	81.78	81.78	85.41	89.05	92.68	96.32	99.95	

∑(44)1...12 = 1090.40 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	148.23	129.64	133.78	116.63	111.91	96.57	89.49	102.69	103.91	121.10	132.19	143.55	

∑(45)1...12 = 1429.69 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	22.23	19.45	20.07	17.49	16.79	14.49	13.42	15.40	15.59	18.17	19.83	21.53	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.94	44.33	47.23	43.91	43.53	40.33	41.67	43.53	43.91	47.23	47.50	50.94	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	199.16	173.97	181.01	160.55	155.44	136.90	131.16	146.21	147.83	168.33	179.69	194.49	(62)

Solar DHW input calculated using Appendix G or Appendix H

NHER

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Flue gas heat recovery system 1 input (Appendix G1)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
-42.55	-34.99	-31.40	-21.61	-14.36	-9.86	-9.17	-10.45	-10.56	-24.06	-33.88	-42.75	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
156.61	138.98	149.61	138.94	141.08	127.04	121.99	135.77	137.27	144.27	145.82	151.73

∑(64)1...12 = | 1689.10 | (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
62.02	54.19	56.29	49.76	48.09	42.19	40.17	45.02	45.53	52.07	55.83	60.46	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	119.30	119.30	119.30	119.30	119.30	119.30	119.30	119.30	119.30	119.30	119.30	119.30	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
19.56	17.37	14.13	10.69	7.99	6.75	7.29	9.48	12.72	16.15	18.85	20.10	(67)

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
211.23	213.42	207.90	196.14	181.29	167.34	158.02	155.83	161.36	173.11	187.96	201.91	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
34.93	34.93	34.93	34.93	34.93	34.93	34.93	34.93	34.93	34.93	34.93	34.93	(69)

Pump and fan gains (Table 5a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)

Losses e.g. evaporation (Table 5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	(71)

Water heating gains (Table 5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
83.36	80.64	75.66	69.11	64.64	58.60	54.00	60.52	63.24	69.99	77.54	81.27	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
375.93	373.22	359.47	337.73	315.72	294.48	281.10	287.62	299.10	321.05	346.14	365.07	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
90.37	176.78	291.12	424.59	520.35	532.67	507.12	435.61	338.59	209.76	112.68	74.31	(83)

Total gains - internal and solar (73)m + (83)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
466.30	549.99	650.59	762.32	836.07	827.15	788.22	723.23	637.69	530.81	458.82	439.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) | 21.00 | (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	1.00	0.99	0.98	0.93	0.80	0.61	0.46	0.51	0.79	0.97	1.00	1.00	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
19.83	20.00	20.28	20.63	20.88	20.98	21.00	20.99	20.92	20.57	20.13	19.80	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.00	20.00	20.00	20.01	20.01	20.02	20.02	20.02	20.01	20.01	20.01	20.00	(88)

Utilisation factor for gains for rest of dwelling n2,m

| 1.00 | 0.99 | 0.98 | 0.91 | 0.75 | 0.53 | 0.36 | 0.41 | 0.71 | 0.95 | 0.99 | 1.00 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| 18.44 | 18.69 | 19.10 | 19.59 | 19.90 | 20.00 | 20.02 | 20.01 | 19.95 | 19.51 | 18.88 | 18.40 | (90) |

Living area fraction   Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

| 18.95 | 19.17 | 19.53 | 19.97 | 20.26 | 20.36 | 20.38 | 20.38 | 20.31 | 19.90 | 19.34 | 18.91 | (92) |

Apply adjustment to the mean internal temperature from Table 4e where appropriate

| 18.80 | 19.02 | 19.38 | 19.82 | 20.11 | 20.21 | 20.23 | 20.23 | 20.16 | 19.75 | 19.19 | 18.76 | (93) |

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.97	0.90	0.76	0.55	0.38	0.43	0.72	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	464.34	544.51	631.26	688.59	631.51	452.28	297.46	312.29	461.77	503.45	454.70	438.00	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1219.41	1184.95	1079.29	907.33	697.26	461.93	298.56	314.47	500.08	758.73	1005.85	1215.84	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	561.77	430.38	333.34	157.49	48.92	0.00	0.00	0.00	0.00	189.93	396.83	578.72	

∑(98)1...5, 10...12 = 2697.38 (98)

Space heating requirement kWh/m²/year   (98) ÷ (4) 35.42 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		92.90	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month												
	604.71	463.27	358.81	169.53	52.66	0.00	0.00	0.00	0.00	204.45	427.16	622.94

∑(211)1...5, 10...12 = 2903.54 (211)

Water heating

Efficiency of water heater

| 90.49 | 90.21 | 89.52 | 87.88 | 85.18 | 82.80 | 82.80 | 82.80 | 82.80 | 88.25 | 89.95 | 90.60 | (217) |

Water heating fuel, kWh/month

| 173.06 | 154.06 | 167.13 | 158.11 | 165.61 | 153.42 | 147.33 | 163.97 | 165.78 | 163.47 | 162.10 | 167.47 | |

∑(219a)1...12 = 1941.53 (219)

Annual totals

Space heating fuel - main system 1	2903.54
Water heating fuel	1941.53

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)

NHER

Total electricity for the above, kWh/year				75.00	(231)
Electricity for lighting (Appendix L)				345.35	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =		5265.42	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2903.54	x	3.48	x 0.01 =	101.04	(240)
Water heating	1941.53	x	3.48	x 0.01 =	67.57	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	345.35	x	13.19	x 0.01 =	45.55	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		344.05	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.19	(257)
SAP value	83.36	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2903.54	x	0.22	=	627.16	(261)
Water heating	1941.53	x	0.22	=	419.37	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1046.53	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	345.35	x	0.52	=	179.24	(268)
Total CO_2, kg/year			(265)...(271) =		1264.70	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		16.61	(273)
EI value					86.01	
EI rating (section 14)					86	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2903.54	x	1.22	=	3542.31	(261)
Water heating	1941.53	x	1.22	=	2368.67	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5910.98	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	345.35	x	3.07	=	1060.23	(268)
Primary energy kWh/year					7201.46	(272)
Dwelling primary energy rate kWh/m2/year					94.56	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 6 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		76.16	(1a) x	2.60	(2a) =	198.02	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	76.16	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		198.02	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2													
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4													
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m													
	0.35	0.34	0.33	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48 x	1.33 =	16.55			(27)
External wall			62.92 x	0.16 =	10.07			(29a)
Party wall			30.42 x	0.00 =	0.00			(32)
Roof			76.16 x	0.15 =	11.42			(30)

Total area of external elements ∑A, m²	151.56	(31)
Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) =	38.04	(33)
Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	9.42	(36)
Total fabric heat loss (33) + (36) =	47.46	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	36.61	36.46	36.31	35.61	35.47	34.86	34.86	34.75	35.10	35.47	35.74	36.02	(38)
Heat transfer coefficient, W/K (37)m + (38)m	84.07	83.92	83.77	83.07	82.93	82.32	82.32	82.21	82.56	82.93	83.20	83.48	

Average = ∑(39)1...12/12 = 83.07 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.10	1.10	1.10	1.09	1.09	1.08	1.08	1.08	1.08	1.09	1.09	1.10	

Average = ∑(40)1...12/12 = 1.09 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.39	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	90.87	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	99.95	96.32	92.68	89.05	85.41	81.78	81.78	85.41	89.05	92.68	96.32	99.95	

∑(44)1...12 = 1090.40 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	148.23	129.64	133.78	116.63	111.91	96.57	89.49	102.69	103.91	121.10	132.19	143.55	

∑(45)1...12 = 1429.69 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	22.23	19.45	20.07	17.49	16.79	14.49	13.42	15.40	15.59	18.17	19.83	21.53	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.94	44.33	47.23	43.91	43.53	40.33	41.67	43.53	43.91	47.23	47.50	50.94	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	199.16	173.97	181.01	160.55	155.44	136.90	131.16	146.21	147.83	168.33	179.69	194.49	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Flue gas heat recovery system 1 input (Appendix G1)

-38.00	-31.25	-27.91	-18.42	-13.14	-9.86	-9.17	-10.45	-10.56	-19.97	-30.08	-38.29	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

161.16	142.73	153.10	142.13	142.30	127.04	121.99	135.77	137.27	148.36	149.61	156.20

∑(64)1...12 = 1717.65 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

62.02	54.19	56.29	49.76	48.09	42.19	40.17	45.02	45.53	52.07	55.83	60.46	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

48.89	43.42	35.31	26.73	19.98	16.87	18.23	23.70	31.81	40.38	47.13	50.25	(67)

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

315.27	318.54	310.29	292.74	270.59	249.77	235.86	232.58	240.83	258.38	280.53	301.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	(69)

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)

Losses e.g. evaporation (Table 5)

-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	(71)

Water heating gains (Table 5)

83.36	80.64	75.66	69.11	64.64	58.60	54.00	60.52	63.24	69.99	77.54	81.27	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

549.94	545.02	523.69	491.01	457.63	427.66	410.50	419.22	438.29	471.18	507.63	535.29	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

90.37	176.78	291.12	424.59	520.35	532.67	507.12	435.61	338.59	209.76	112.68	74.31	(83)

Total gains - internal and solar (73)m + (83)m

640.30	721.79	814.81	915.60	977.98	960.33	917.63	854.83	776.88	680.94	620.30	609.61	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C)   21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	0.99	0.98	0.96	0.88	0.73	0.54	0.39	0.44	0.69	0.92	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.04	20.20	20.46	20.75	20.92	20.99	21.00	21.00	20.96	20.71	20.32	20.01	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.00	20.00	20.00	20.01	20.01	20.02	20.02	20.02	20.01	20.01	20.01	20.00	(88)

Utilisation factor for gains for rest of dwelling n2,m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.99	0.98	0.94	0.84	0.67	0.46	0.31	0.35	0.61	0.89	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	18.75	18.97	19.34	19.73	19.94	20.01	20.02	20.02	19.98	19.69	19.15	18.70	(90)

Living area fraction Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	19.22	19.43	19.75	20.11	20.31	20.37	20.38	20.38	20.34	20.07	19.58	19.18	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	19.07	19.28	19.60	19.96	20.16	20.22	20.23	20.23	20.19	19.92	19.43	19.03	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, η_m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.98	0.97	0.94	0.84	0.68	0.48	0.32	0.37	0.62	0.89	0.97	0.99	(94)

Useful gains, $\eta_m G_m$, W (94)m x (84)m

	630.20	700.89	762.01	770.18	661.69	457.51	298.13	313.67	483.80	604.73	601.93	601.87	(95)

Monthly average external temperature from Table U1

	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

	1242.12	1206.50	1097.45	918.47	701.22	462.62	298.66	314.67	502.98	772.69	1025.99	1238.11	(97)

Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

	455.27	339.77	249.57	106.77	29.41	0.00	0.00	0.00	0.00	124.97	305.32	473.36

∑(98)1...5, 10...12 = 2084.44 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) 27.37 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Space heating fuel (main system 1), kWh/month

	490.06	365.73	268.64	114.93	31.66	0.00	0.00	0.00	0.00	134.52	328.66	509.54

∑(211)1...5, 10...12 = 2243.74 (211)

Water heating

Efficiency of water heater

	90.03	89.66	88.78	86.85	84.37	82.80	82.80	82.80	82.80	87.13	89.32	90.17	(217)

Water heating fuel, kWh/month

	179.01	159.18	172.44	163.64	168.66	153.42	147.33	163.97	165.78	170.27	167.51	173.23

∑(219a)1...12 = 1984.45 (219)

Annual totals

Space heating fuel - main system 1 2243.74

Water heating fuel 1984.45

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit 30.00 (230c)

boiler flue fan 45.00 (230e)

Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		345.35	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4648.54	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2243.74	x	3.48	x 0.01 =	78.08	(240)
Water heating	1984.45	x	3.48	x 0.01 =	69.06	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	345.35	x	13.19	x 0.01 =	45.55	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		322.59	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.12	(257)
SAP value	84.40	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2243.74	x	0.22	=	484.65	(261)
Water heating	1984.45	x	0.22	=	428.64	(264)
Space and water heating			(261) + (262) + (263) + (264) =		913.29	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	345.35	x	0.52	=	179.24	(268)
Total CO_2, kg/year			(265)...(271) =		1131.45	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		14.86	(273)
EI value					87.49	
EI rating (section 14)					87	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2243.74	x	1.22	=	2737.37	(261)
Water heating	1984.45	x	1.22	=	2421.03	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5158.39	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	345.35	x	3.07	=	1060.23	(268)
Primary energy kWh/year					6448.87	(272)
Dwelling primary energy rate kWh/m2/year					84.68	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 6 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		76.16	(1a) x	2.60	(2a) =	198.02	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	76.16	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		198.02	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2													
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4													
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m													
	0.35	0.34	0.33	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48 x	1.33 =	16.55			(27)
External wall			62.92 x	0.16 =	10.07			(29a)
Party wall			30.42 x	0.00 =	0.00			(32)
Roof			76.16 x	0.12 =	9.14			(30)

Total area of external elements ∑A, m²	151.56	(31)
Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) = 35.75	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) = N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	9.42	(36)
Total fabric heat loss	(33) + (36) = 45.17	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	36.61	36.46	36.31	35.61	35.47	34.86	34.86	34.75	35.10	35.47	35.74	36.02	(38)
Heat transfer coefficient, W/K (37)m + (38)m	81.79	81.64	81.49	80.78	80.65	80.04	80.04	79.92	80.27	80.65	80.92	81.19	

Average = ∑(39)1...12/12 = 80.78 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.07	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.05	1.06	1.06	1.07	

Average = ∑(40)1...12/12 = 1.06 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.39	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	90.87	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	99.95	96.32	92.68	89.05	85.41	81.78	81.78	85.41	89.05	92.68	96.32	99.95	

∑(44)1...12 = 1090.40 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	148.23	129.64	133.78	116.63	111.91	96.57	89.49	102.69	103.91	121.10	132.19	143.55	

∑(45)1...12 = 1429.69 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	22.23	19.45	20.07	17.49	16.79	14.49	13.42	15.40	15.59	18.17	19.83	21.53	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	125.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	0.99	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.77	(54)
Enter (50) or (54) in (55)	0.77	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

NHER

| 23.84 | 21.53 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | (57) |

Primary circuit loss for each month from Table 3

| 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss for each month from Table 3a, 3b or 3c

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (61) |

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

| 195.33 | 172.18 | 180.88 | 162.21 | 159.01 | 142.15 | 136.59 | 149.79 | 149.49 | 168.20 | 177.77 | 190.65 | (62) |

Solar DHW input calculated using Appendix G or Appendix H

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (63) |

Output from water heater for each month (kWh/month) (62)m + (63)m

| 195.33 | 172.18 | 180.88 | 162.21 | 159.01 | 142.15 | 136.59 | 149.79 | 149.49 | 168.20 | 177.77 | 190.65 | |

∑(64)1...12 = | 1984.24 | (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45) + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

| 86.97 | 77.14 | 82.16 | 75.24 | 74.89 | 68.57 | 67.43 | 71.82 | 71.02 | 77.95 | 80.42 | 85.41 | (65) |

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Metabolic gains (Table 5)

| 119.30 | 119.30 | 119.30 | 119.30 | 119.30 | 119.30 | 119.30 | 119.30 | 119.30 | 119.30 | 119.30 | 119.30 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| 19.56 | 17.37 | 14.13 | 10.69 | 7.99 | 6.75 | 7.29 | 9.48 | 12.72 | 16.15 | 18.85 | 20.10 | (67) |

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| 211.23 | 213.42 | 207.90 | 196.14 | 181.29 | 167.34 | 158.02 | 155.83 | 161.36 | 173.11 | 187.96 | 201.91 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| 34.93 | 34.93 | 34.93 | 34.93 | 34.93 | 34.93 | 34.93 | 34.93 | 34.93 | 34.93 | 34.93 | 34.93 | (69) |

Pump and fan gains (Table 5a)

| 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | (70) |

Losses e.g. evaporation (Table 5)

| -95.44 | -95.44 | -95.44 | -95.44 | -95.44 | -95.44 | -95.44 | -95.44 | -95.44 | -95.44 | -95.44 | -95.44 | (71) |

Water heating gains (Table 5)

| 116.89 | 114.79 | 110.43 | 104.51 | 100.66 | 95.24 | 90.64 | 96.54 | 98.63 | 104.77 | 111.69 | 114.80 | (72) |

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| 409.46 | 407.37 | 394.24 | 373.13 | 351.74 | 331.12 | 317.74 | 323.64 | 334.50 | 355.82 | 380.29 | 398.60 | (73) |

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

| 90.37 | 176.78 | 291.12 | 424.59 | 520.35 | 532.67 | 507.12 | 435.61 | 338.59 | 209.76 | 112.68 | 74.31 | (83) |

Total gains - internal and solar (73)m + (83)m

| 499.83 | 584.14 | 685.37 | 797.71 | 872.08 | 863.79 | 824.86 | 759.25 | 673.09 | 565.58 | 492.97 | 472.91 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) | 21.00 | (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1.00	0.99	0.98	0.91	0.77	0.58	0.42	0.48	0.75	0.96	0.99	1.00	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
19.92	20.08	20.36	20.69	20.91	20.98	21.00	21.00	20.94	20.63	20.20	19.88	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.02	20.02	20.03	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.03	20.03	(88)

Utilisation factor for gains for rest of dwelling n2,m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1.00	0.99	0.97	0.89	0.72	0.50	0.33	0.38	0.67	0.94	0.99	1.00	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
18.58	18.82	19.22	19.68	19.95	20.03	20.04	20.04	19.99	19.61	19.01	18.54	(90)

Living area fraction   Living area ÷ (4) =   **0.37**   (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
19.07	19.29	19.64	20.05	20.30	20.38	20.39	20.39	20.34	19.99	19.45	19.03	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
19.07	19.29	19.64	20.05	20.30	20.38	20.39	20.39	20.34	19.99	19.45	19.03	(93)

8. Space heating requirement

Utilisation factor for gains, ηm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.99	0.99	0.96	0.89	0.73	0.53	0.37	0.42	0.70	0.94	0.99	1.00	(94)

Useful gains, ηmGm, W (94)m x (84)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
497.12	576.90	661.02	709.50	639.60	455.31	302.73	317.40	470.37	530.18	487.23	470.96	(95)

Monthly average external temperature from Table U1

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1208.16	1174.41	1070.81	901.08	693.68	462.81	303.60	319.10	501.11	757.01	999.21	1204.34	(97)

Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
529.01	401.53	304.89	137.94	40.23	0.00	0.00	0.00	0.00	168.76	368.62	545.64	

∑(98)1...5, 10...12 =   **2496.62**   (98)

Space heating requirement kWh/m²/year   (98) ÷ (4)   **32.78**   (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)   **0.00**   (201)

Fraction of space heat from main system(s)   1 - (201) =   **1.00**   (202)

Fraction of space heat from main system 2   **0.00**   (202)

Fraction of total space heat from main system 1   (202) x [1- (203)] =   **1.00**   (204)

Fraction of total space heat from main system 2   (202) x (203) =   **0.00**   (205)

Efficiency of main system 1 (%)   **249.90**   (206)

Space heating fuel (main system 1), kWh/month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
211.69	160.67	122.00	55.20	16.10	0.00	0.00	0.00	0.00	67.53	147.51	218.34

∑(211)1...5, 10...12 =   **999.05**   (211)

Water heating

Efficiency of water heater

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	(217)

Water heating fuel, kWh/month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
111.55	98.33	103.30	92.64	90.81	81.18	78.00	85.54	85.38	96.06	101.53	108.88

∑(219a)1...12 =   **1133.20**   (219)

Annual totals

Space heating fuel - main system 1	999.05	
Water heating fuel	1133.20	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
Total electricity for the above, kWh/year	30.00	(231)
Electricity for lighting (Appendix L)	345.35	(232)
Energy saving/generation technologies		
electricity generated by PV (Appendix M)	-823.35	(233)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 1684.25	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	999.05	x	13.19	x 0.01 =	131.77	(240)
Water heating	1133.20	x	13.19	x 0.01 =	149.47	(247)
Pumps and fans	30.00	x	13.19	x 0.01 =	3.96	(249)
Electricity for lighting	345.35	x	13.19	x 0.01 =	45.55	(250)
Additional standing charges					0.00	(251)
Energy saving/generation technologies						
pv savings	-823.35	x	13.19	x 0.01 =	0.00	(252)
Total energy cost			(240)...(242) + (245)...(254) =		330.75	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.15	(257)
SAP value	84.01	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO$_2$ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO$_2$/kWh		Emissions kg CO$_2$/year	
Space heating - main system 1	999.05	x	0.52	=	518.51	(261)
Water heating	1133.20	x	0.52	=	588.13	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1106.64	(265)
Pumps and fans	30.00	x	0.52	=	15.57	(267)
Electricity for lighting	345.35	x	0.52	=	179.24	(268)
Energy saving/generation technologies						
pv savings	-823.35	x	0.52	=	-427.32	(269)
Total CO$_2$, kg/year			(265)...(271) =		874.13	(272)
Dwelling CO$_2$ emission rate			(272) ÷ (4) =		11.48	(273)
EI value					90.33	
EI rating (section 14)					90	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	999.05	x	3.07	=	3067.08	(261)

Water heating	1133.20	x	3.07	=	3478.94	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6546.02	(265)
Pumps and fans	30.00	x	3.07	=	92.10	(267)
Electricity for lighting	345.35	x	3.07	=	1060.23	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-823.35	x	3.07	=	-2527.68	(269)
Primary energy kWh/year					5170.66	(272)
Dwelling primary energy rate kWh/m2/year					67.89	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 6 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		76.16 (1a)	x	2.60 (2a)	=	198.02	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	76.16 (4)					
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =			198.02	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] = 0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.27	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.35	0.34	0.33	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48 x	1.33 =	16.55			(27)
External wall			62.92 x	0.16 =	10.07			(29a)
Party wall			30.42 x	0.00 =	0.00			(32)
Roof			76.16 x	0.12 =	9.14			(30)

Total area of external elements ∑A, m²	151.56	(31)
Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) =	35.75	(33)
Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	9.42	(36)
Total fabric heat loss (33) + (36) =	45.17	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	36.61	36.46	36.31	35.61	35.47	34.86	34.86	34.75	35.10	35.47	35.74	36.02	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	81.79	81.64	81.49	80.78	80.65	80.04	80.04	79.92	80.27	80.65	80.92	81.19	

Average = ∑(39)1...12/12 = 80.78 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.07	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.05	1.06	1.06	1.07	

Average = ∑(40)1...12/12 = 1.06 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)													
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.39	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	90.87	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	99.95	96.32	92.68	89.05	85.41	81.78	81.78	85.41	89.05	92.68	96.32	99.95	

∑(44)1...12 = 1090.40 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	148.23	129.64	133.78	116.63	111.91	96.57	89.49	102.69	103.91	121.10	132.19	143.55	

∑(45)1...12 = 1429.69 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m													
	22.23	19.45	20.07	17.49	16.79	14.49	13.42	15.40	15.59	18.17	19.83	21.53	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	125.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	0.99	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.77	(54)
Enter (50) or (54) in (55)	0.77	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m													
	23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

NHER

| 23.84 | 21.53 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | (57) |

Primary circuit loss for each month from Table 3

| 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss for each month from Table 3a, 3b or 3c

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (61) |

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

| 195.33 | 172.18 | 180.88 | 162.21 | 159.01 | 142.15 | 136.59 | 149.79 | 149.49 | 168.20 | 177.77 | 190.65 | (62) |

Solar DHW input calculated using Appendix G or Appendix H

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (63) |

Output from water heater for each month (kWh/month) (62)m + (63)m

| 195.33 | 172.18 | 180.88 | 162.21 | 159.01 | 142.15 | 136.59 | 149.79 | 149.49 | 168.20 | 177.77 | 190.65 | |

∑(64)1...12 = **1984.24** (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

| 86.97 | 77.14 | 82.16 | 75.24 | 74.89 | 68.57 | 67.43 | 71.82 | 71.02 | 77.95 | 80.42 | 85.41 | (65) |

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	143.16	(66)
Lighting gains (Appendix L, eq L9/L9a, Table 5)	48.89	43.42	35.31	26.73	19.98	16.87	18.23	23.70	31.81	40.38	47.13	50.25	(67)
Appliance gains (Appendix L, eq L13/L13a, Table 5)	315.27	318.54	310.29	292.74	270.59	249.77	235.86	232.58	240.83	258.38	280.53	301.36	(68)
Cooking gains (Appendix L, eq L15/L15a, Table 5)	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	-95.44	(71)
Water heating gains (Table 5)	116.89	114.79	110.43	104.51	100.66	95.24	90.64	96.54	98.63	104.77	111.69	114.80	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	583.46	579.17	558.46	526.40	493.65	464.30	447.14	455.24	473.69	505.95	541.78	568.82	(73)

The headers for rows 67, 68, 69 are:

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

| 90.37 | 176.78 | 291.12 | 424.59 | 520.35 | 532.67 | 507.12 | 435.61 | 338.59 | 209.76 | 112.68 | 74.31 | (83) |

Total gains - internal and solar (73)m + (83)m

| 673.83 | 755.95 | 849.58 | 950.99 | 1014.00 | 996.97 | 954.27 | 890.85 | 812.28 | 715.71 | 654.46 | 643.14 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)   **21.00** (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.99	0.98	0.94	0.85	0.70	0.51	0.37	0.41	0.65	0.90	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.12	20.28	20.53	20.79	20.94	20.99	21.00	21.00	20.97	20.76	20.39	20.09	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.02	20.02	20.03	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.03	20.03	(88)

Utilisation factor for gains for rest of dwelling $n_{2,m}$

0.98	0.97	0.93	0.82	0.64	0.43	0.29	0.33	0.57	0.87	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.88	19.11	19.45	19.81	19.99	20.04	20.04	20.04	20.02	19.78	19.27	18.84	(90)

Living area fraction   Living area ÷ (4) = **0.37** (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.34	19.54	19.85	20.17	20.34	20.39	20.39	20.39	20.37	20.14	19.69	19.30	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.34	19.54	19.85	20.17	20.34	20.39	20.39	20.39	20.37	20.14	19.69	19.30	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, η_m	0.98	0.97	0.93	0.82	0.66	0.46	0.32	0.36	0.60	0.87	0.96	0.98	(94)
Useful gains, $\eta_m G_m$, W (94)m x (84)m	661.08	730.21	786.49	783.67	664.74	459.31	303.23	318.43	488.00	623.98	631.17	633.23	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1230.12	1195.02	1087.68	910.66	696.69	463.27	303.66	319.22	503.19	769.31	1018.41	1225.91	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	423.36	312.35	224.08	91.43	23.78	0.00	0.00	0.00	0.00	108.12	278.81	440.96	

∑(98)1...5, 10...12 = **1902.90** (98)

Space heating requirement kWh/m²/year   (98) ÷ (4) **24.99** (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		249.90	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	169.41	124.99	89.67	36.59	9.51	0.00	0.00	0.00	0.00	43.27	111.57	176.45

∑(211)1...5, 10...12 = **761.46** (211)

Water heating

Efficiency of water heater

175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	(217)

Water heating fuel, kWh/month

111.55	98.33	103.30	92.64	90.81	81.18	78.00	85.54	85.38	96.06	101.53	108.88	

∑(219a)1...12 = **1133.20** (219)

Annual totals

Space heating fuel - main system 1	761.46	
Water heating fuel	1133.20	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
Total electricity for the above, kWh/year	30.00	(231)
Electricity for lighting (Appendix L)	345.35	(232)
Energy saving/generation technologies		
electricity generated by PV (Appendix M)	-823.35	(233)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 1446.67	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	761.46	x	13.19	x 0.01 =	100.44	(240)
Water heating	1133.20	x	13.19	x 0.01 =	149.47	(247)
Pumps and fans	30.00	x	13.19	x 0.01 =	3.96	(249)
Electricity for lighting	345.35	x	13.19	x 0.01 =	45.55	(250)
Additional standing charges					0.00	(251)
Energy saving/generation technologies						
pv savings	-823.35	x	13.19	x 0.01 =	0.00	(252)
Total energy cost			(240)...(242) + (245)...(254) =		299.42	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.04	(257)
SAP value	85.52	
SAP rating (section 13)	86	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO$_2$/kWh		Emissions kg CO$_2$/year	
Space heating - main system 1	761.46	x	0.52	=	395.20	(261)
Water heating	1133.20	x	0.52	=	588.13	(264)
Space and water heating			(261) + (262) + (263) + (264) =		983.33	(265)
Pumps and fans	30.00	x	0.52	=	15.57	(267)
Electricity for lighting	345.35	x	0.52	=	179.24	(268)
Energy saving/generation technologies						
pv savings	-823.35	x	0.52	=	-427.32	(269)
Total CO$_2$, kg/year			(265)...(271) =		750.82	(272)
Dwelling CO$_2$ emission rate			(272) ÷ (4) =		9.86	(273)
EI value					91.70	
EI rating (section 14)					92	(274)
EI band					A	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	761.46	x	3.07	=	2337.69	(261)

Water heating	1133.20	x	3.07	=	3478.94	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5816.63	(265)
Pumps and fans	30.00	x	3.07	=	92.10	(267)
Electricity for lighting	345.35	x	3.07	=	1060.23	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-823.35	x	3.07	=	-2527.68	(269)
Primary energy kWh/year					4441.28	(272)
Dwelling primary energy rate kWh/m2/year					58.32	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 5 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		49.62	(1a) x	2.60	(2a) =	129.01	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.62	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		129.01	(5)

2. Ventilation rate

		m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	3	x 10 =	30	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.23	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.43	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.39	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48 x	1.33 =	16.55			(27)
External wall			27.82 x	0.28 =	7.79			(29a)
Party wall			46.28 x	0.00 =	0.00			(32)
Roof			49.62 x	0.15 =	7.44			(30)
Total area of external elements ∑A, m²			89.92					(31)

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 31.78 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K 250.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 9.42 (36)

Total fabric heat loss (33) + (36) = 41.20 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	25.18	25.02	24.88	24.18	24.05	23.45	23.45	23.33	23.68	24.05	24.31	24.59	(38)
Heat transfer coefficient, W/K (37)m + (38)m	66.38	66.23	66.08	65.38	65.25	64.65	64.65	64.53	64.88	65.25	65.52	65.79	(39)

Average = ∑(39)1...12/12 = 65.38 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.34	1.33	1.33	1.32	1.32	1.30	1.30	1.30	1.31	1.32	1.32	1.33	(40)

Average = ∑(40)1...12/12 = 1.32 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N 1.68 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.07 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	81.48	78.52	75.56	72.59	69.63	66.67	66.67	69.63	72.59	75.56	78.52	81.48	

∑(44)1...12 = 888.89 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	120.84	105.68	109.06	95.08	91.23	78.72	72.95	83.71	84.71	98.72	107.76	117.02	

∑(45)1...12 = 1165.48 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	18.13	15.85	16.36	14.26	13.68	11.81	10.94	12.56	12.71	14.81	16.16	17.55	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	41.52	36.14	38.50	35.80	35.48	32.88	33.97	35.48	35.80	38.50	38.72	41.52	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	162.36	141.82	147.56	130.88	126.71	111.60	106.92	119.19	120.51	137.22	146.48	158.54	(62)

Solar DHW input calculated using Appendix G or Appendix H

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (63) |

Flue gas heat recovery system 1 input (Appendix G1)

| -34.55 | -28.36 | -25.40 | -16.52 | -11.43 | -8.06 | -7.47 | -8.58 | -8.69 | -18.97 | -27.75 | -34.64 | (63) |

Output from water heater for each month (kWh/month) (62)m + (63)m

| 127.81 | 113.46 | 122.16 | 114.36 | 115.29 | 103.54 | 99.45 | 110.61 | 111.82 | 118.26 | 118.74 | 123.90 | |

∑(64)1...12 = 1379.38 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

| 50.56 | 44.17 | 45.89 | 40.56 | 39.20 | 34.39 | 32.75 | 36.70 | 37.12 | 42.45 | 45.51 | 49.29 | (65) |

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	83.95	83.95	83.95	83.95	83.95	83.95	83.95	83.95	83.95	83.95	83.95	83.95	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.04	11.58	9.42	7.13	5.33	4.50	4.86	6.32	8.48	10.77	12.57	13.40	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	146.25	147.76	143.94	135.80	125.52	115.86	109.41	107.89	111.72	119.86	130.14	139.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.39	31.39	31.39	31.39	31.39	31.39	31.39	31.39	31.39	31.39	31.39	31.39	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	(71)
Water heating gains (Table 5)	67.95	65.74	61.68	56.34	52.69	47.77	44.02	49.33	51.55	57.06	63.21	66.25	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	278.42	276.26	266.22	250.45	234.73	219.32	209.47	214.73	222.93	238.87	257.10	270.63	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

| 90.37 | 176.78 | 291.12 | 424.59 | 520.35 | 532.67 | 507.12 | 435.61 | 338.59 | 209.76 | 112.68 | 74.31 | (83) |

Total gains - internal and solar (73)m + (83)m

| 368.79 | 453.04 | 557.34 | 675.04 | 755.08 | 751.99 | 716.60 | 650.34 | 561.52 | 448.63 | 369.78 | 344.94 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C)   21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.96	0.88	0.72	0.53	0.39	0.45	0.72	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.64	19.87	20.23	20.63	20.88	20.98	21.00	20.99	20.92	20.53	20.00	19.60	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.81	19.81	19.82	19.83	19.83	19.84	19.84	19.84	19.83	19.83	19.82	19.82	(88)

Utilisation factor for gains for rest of dwelling n2,m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.99	0.98	0.95	0.84	0.65	0.44	0.29	0.34	0.62	0.92	0.99	1.00	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	18.03	18.36	18.87	19.43	19.73	19.83	19.84	19.84	19.78	19.31	18.56	17.98	(90)

Living area fraction   Living area ÷ (4) = | 0.57 | (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	18.94	19.21	19.64	20.11	20.38	20.48	20.49	20.49	20.42	20.00	19.38	18.90	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	18.79	19.06	19.49	19.96	20.23	20.33	20.34	20.34	20.27	19.85	19.23	18.75	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.98	0.94	0.85	0.68	0.48	0.34	0.39	0.66	0.92	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	365.62	443.80	526.12	570.89	511.45	362.62	240.81	252.16	371.20	411.27	363.38	342.68	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	962.10	937.93	858.28	723.31	556.77	370.23	241.96	254.32	400.44	603.73	794.48	957.24	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	443.78	332.05	247.13	109.75	33.72	0.00	0.00	0.00	0.00	143.19	310.39	457.23	

∑(98)1...5, 10...12 = | 2077.24 | (98)

Space heating requirement kWh/m²/year   (98) ÷ (4) | 41.86 | (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) | 0.00 | (201)

Fraction of space heat from main system(s)   1 - (201) = | 1.00 | (202)

Fraction of space heat from main system 2 | 0.00 | (202)

Fraction of total space heat from main system 1   (202) x [1- (203)] = | 1.00 | (204)

Fraction of total space heat from main system 2   (202) x (203) = | 0.00 | (205)

Efficiency of main system 1 (%) | 92.90 | (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month													
	477.70	357.43	266.01	118.13	36.29	0.00	0.00	0.00	0.00	154.14	334.11	492.18	

∑(211)1...5, 10...12 = | 2236.00 | (211)

Water heating

Efficiency of water heater

	90.43	90.10	89.30	87.46	84.89	82.80	82.80	82.80	82.80	88.04	89.87	90.55	(217)

Water heating fuel, kWh/month

	141.33	125.93	136.80	130.76	135.81	125.04	120.11	133.59	135.05	134.32	132.13	136.84	

∑(219a)1...12 = | 1587.70 | (219)

Annual totals

Space heating fuel - main system 1 | 2236.00 |

Water heating fuel | 1587.70 |

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit | 30.00 | (230c)

boiler flue fan | 45.00 | (230e)

Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		230.26	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4128.95	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2236.00	x	3.48	x 0.01 =	77.81	(240)
Water heating	1587.70	x	3.48	x 0.01 =	55.25	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	230.26	x	13.19	x 0.01 =	30.37	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		293.33	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.30	(257)
SAP value	81.84	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2236.00	x	0.22	=	482.98	(261)
Water heating	1587.70	x	0.22	=	342.94	(264)
Space and water heating			(261) + (262) + (263) + (264) =		825.92	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	230.26	x	0.52	=	119.50	(268)
Total CO_2, kg/year			(265)...(271) =		984.35	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		19.84	(273)
EI value					86.06	
EI rating (section 14)					86	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2236.00	x	1.22	=	2727.92	(261)
Water heating	1587.70	x	1.22	=	1936.99	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4664.90	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	230.26	x	3.07	=	706.88	(268)
Primary energy kWh/year					5602.04	(272)
Dwelling primary energy rate kWh/m2/year					112.90	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 5 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		49.62	(1a) x	2.60	(2a) =	129.01	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.62	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		129.01	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.23	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.43	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2													
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4													
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m													
	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.39	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48 x	1.33 =	16.55			(27)
External wall			27.82 x	0.28 =	7.79			(29a)
Party wall			46.28 x	0.00 =	0.00			(32)
Roof			49.62 x	0.15 =	7.44			(30)

Total area of external elements ∑A, m²	89.92	(31)
Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) =	31.78	(33)
Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	9.42	(36)
Total fabric heat loss (33) + (36) =	41.20	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	25.18	25.02	24.88	24.18	24.05	23.45	23.45	23.33	23.68	24.05	24.31	24.59	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	66.38	66.23	66.08	65.38	65.25	64.65	64.65	64.53	64.88	65.25	65.52	65.79	

Average = ∑(39)1...12/12 = 65.38 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.34	1.33	1.33	1.32	1.32	1.30	1.30	1.30	1.31	1.32	1.32	1.33	

Average = ∑(40)1...12/12 = 1.32 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)													
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.68	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.07	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	81.48	78.52	75.56	72.59	69.63	66.67	66.67	69.63	72.59	75.56	78.52	81.48	

∑(44)1...12 = 888.89 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	120.84	105.68	109.06	95.08	91.23	78.72	72.95	83.71	84.71	98.72	107.76	117.02	

∑(45)1...12 = 1165.48 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m													
	18.13	15.85	16.36	14.26	13.68	11.81	10.94	12.56	12.71	14.81	16.16	17.55	(46)
Water storage loss calculated for each month (55) x (41)m													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c													
	41.52	36.14	38.50	35.80	35.48	32.88	33.97	35.48	35.80	38.50	38.72	41.52	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m													
	162.36	141.82	147.56	130.88	126.71	111.60	106.92	119.19	120.51	137.22	146.48	158.54	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Flue gas heat recovery system 1 input (Appendix G1)

-31.59	-25.99	-23.16	-14.71	-10.77	-8.06	-7.47	-8.58	-8.69	-16.41	-25.32	-31.73	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

130.77	115.83	124.39	116.17	115.94	103.54	99.45	110.61	111.82	120.82	121.17	126.81

$\sum(64)1...12 =$ [1397.31] (64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

50.56	44.17	45.89	40.56	39.20	34.39	32.75	36.70	37.12	42.45	45.51	49.29	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	100.74	100.74	100.74	100.74	100.74	100.74	100.74	100.74	100.74	100.74	100.74	100.74	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

32.60	28.95	23.54	17.82	13.32	11.25	12.15	15.80	21.21	26.93	31.43	33.50	(67)

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

218.28	220.54	214.84	202.68	187.35	172.93	163.30	161.03	166.74	178.89	194.23	208.65	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

46.75	46.75	46.75	46.75	46.75	46.75	46.75	46.75	46.75	46.75	46.75	46.75	(69)

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)

Losses e.g. evaporation (Table 5)

-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	(71)

Water heating gains (Table 5)

67.95	65.74	61.68	56.34	52.69	47.77	44.02	49.33	51.55	57.06	63.21	66.25	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

402.16	398.56	383.39	360.18	336.69	315.28	302.80	309.50	322.83	346.21	372.20	391.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts $\sum(74)m...(82)m$

90.37	176.78	291.12	424.59	520.35	532.67	507.12	435.61	338.59	209.76	112.68	74.31	(83)

Total gains - internal and solar (73)m + (83)m

492.53	575.34	674.51	784.77	857.04	847.95	809.92	745.11	661.42	555.97	484.87	466.04	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) [21.00] (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	0.98	0.97	0.93	0.82	0.66	0.48	0.35	0.39	0.63	0.89	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.86	20.07	20.39	20.73	20.92	20.98	21.00	21.00	20.95	20.66	20.19	19.82	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.81	19.81	19.82	19.83	19.83	19.84	19.84	19.84	19.83	19.83	19.82	19.82	(88)

Utilisation factor for gains for rest of dwelling n2,m

| 0.98 | 0.96 | 0.91 | 0.78 | 0.59 | 0.40 | 0.26 | 0.30 | 0.54 | 0.85 | 0.96 | 0.98 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| 18.35 | 18.65 | 19.10 | 19.55 | 19.76 | 19.83 | 19.84 | 19.84 | 19.80 | 19.48 | 18.84 | 18.29 | (90) |

Living area fraction | Living area ÷ (4) = | 0.57 | (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

| 19.20 | 19.45 | 19.83 | 20.22 | 20.42 | 20.48 | 20.49 | 20.49 | 20.45 | 20.15 | 19.60 | 19.16 | (92) |

Apply adjustment to the mean internal temperature from Table 4e where appropriate

| 19.05 | 19.30 | 19.68 | 20.07 | 20.27 | 20.33 | 20.34 | 20.34 | 20.30 | 20.00 | 19.45 | 19.01 | (93) |

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, ηm

| 0.98 | 0.96 | 0.90 | 0.79 | 0.62 | 0.43 | 0.30 | 0.34 | 0.58 | 0.86 | 0.96 | 0.98 | (94) |

Useful gains, ηmGm, W (94)m x (84)m

| 480.84 | 549.89 | 610.18 | 618.35 | 527.93 | 365.81 | 241.35 | 253.23 | 384.71 | 476.25 | 464.34 | 457.02 | (95) |

Monthly average external temperature from Table U1

| 4.30 | 4.90 | 6.50 | 8.90 | 11.70 | 14.60 | 16.60 | 16.40 | 14.10 | 10.60 | 7.10 | 4.20 | (96) |

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

| 979.21 | 953.79 | 870.89 | 730.19 | 559.04 | 370.67 | 242.04 | 254.48 | 402.32 | 613.33 | 809.43 | 974.06 | (97) |

Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

| 370.79 | 271.42 | 193.97 | 80.53 | 23.15 | 0.00 | 0.00 | 0.00 | 0.00 | 101.99 | 248.47 | 384.68 | |

| ∑(98)1...5, 10...12 = | 1674.99 | (98) |

Space heating requirement kWh/m²/year | (98) ÷ (4) | 33.76 | (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) | 0.00 | (201)

Fraction of space heat from main system(s) | 1 - (201) = | 1.00 | (202)

Fraction of space heat from main system 2 | 0.00 | (202)

Fraction of total space heat from main system 1 | (202) x [1- (203)] = | 1.00 | (204)

Fraction of total space heat from main system 2 | (202) x (203) = | 0.00 | (205)

Efficiency of main system 1 (%) | 92.90 | (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Space heating fuel (main system 1), kWh/month

| 399.13 | 292.17 | 208.79 | 86.68 | 24.92 | 0.00 | 0.00 | 0.00 | 0.00 | 109.78 | 267.45 | 414.08 | |

| ∑(211)1...5, 10...12 = | 1803.00 | (211) |

Water heating

Efficiency of water heater

| 90.04 | 89.63 | 88.67 | 86.66 | 84.33 | 82.80 | 82.80 | 82.80 | 82.80 | 87.14 | 89.33 | 90.17 | (217) |

Water heating fuel, kWh/month

| 145.24 | 129.23 | 140.28 | 134.05 | 137.49 | 125.04 | 120.11 | 133.59 | 135.05 | 138.65 | 135.64 | 140.63 | |

| ∑(219a)1...12 = | 1615.01 | (219) |

Annual totals

Space heating fuel - main system 1 | 1803.00

Water heating fuel | 1615.01

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit | 30.00 | (230c)

boiler flue fan | 45.00 | (230e)

Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		230.26	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3723.27	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1803.00	x	3.48	x 0.01 =	62.74	(240)
Water heating	1615.01	x	3.48	x 0.01 =	56.20	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	230.26	x	13.19	x 0.01 =	30.37	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		279.21	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.24	(257)
SAP value	82.71	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO$_2$ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO$_2$/kWh		Emissions kg CO$_2$/year	
Space heating - main system 1	1803.00	x	0.22	=	389.45	(261)
Water heating	1615.01	x	0.22	=	348.84	(264)
Space and water heating			(261) + (262) + (263) + (264) =		738.29	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	230.26	x	0.52	=	119.50	(268)
Total CO$_2$, kg/year			(265)...(271) =		896.72	(272)
Dwelling CO$_2$ emission rate			(272) ÷ (4) =		18.07	(273)
EI value					87.30	
EI rating (section 14)					87	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1803.00	x	1.22	=	2199.66	(261)
Water heating	1615.01	x	1.22	=	1970.31	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4169.98	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	230.26	x	3.07	=	706.88	(268)
Primary energy kWh/year					5107.11	(272)
Dwelling primary energy rate kWh/m2/year					102.92	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell		Assessor number	3635
Client			Last modified	08/03/2016
Address	Unit 6 1a Highgate Road, London, NW5 1JY			

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		49.92	(1a) x	2.60	(2a) =	129.79	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.92	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		129.79	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.23	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.43	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48 x	1.33	= 16.55			(27)
External wall			27.82 x	0.16	= 4.45			(29a)
Party wall			46.28 x	0.00	= 0.00			(32)
Roof			49.92 x	0.15	= 7.49			(30)

Total area of external elements ∑A, m²	90.22	(31)
Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) = 28.48	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) = N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	9.42	(36)
Total fabric heat loss	(33) + (36) = 37.91	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	25.30	25.15	25.00	24.31	24.18	23.57	23.57	23.46	23.81	24.18	24.44	24.72	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	63.21	63.06	62.91	62.22	62.09	61.48	61.48	61.37	61.71	62.09	62.35	62.62	

Average = ∑(39)1...12/12 = 62.22 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.27	1.26	1.26	1.25	1.24	1.23	1.23	1.23	1.24	1.24	1.25	1.25	

Average = ∑(40)1...12/12 = 1.25 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)													
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.28	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	81.71	78.74	75.77	72.80	69.83	66.86	66.86	69.83	72.80	75.77	78.74	81.71	

∑(44)1...12 = 891.41 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	121.18	105.98	109.36	95.35	91.49	78.95	73.16	83.95	84.95	99.00	108.07	117.35	

∑(45)1...12 = 1168.78 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m													
	18.18	15.90	16.40	14.30	13.72	11.84	10.97	12.59	12.74	14.85	16.21	17.60	(46)
Water storage loss calculated for each month (55) x (41)m													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c													
	41.64	36.24	38.61	35.90	35.58	32.97	34.07	35.58	35.90	38.61	38.83	41.64	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m													
	162.82	142.22	147.98	131.25	127.07	111.92	107.22	119.53	120.85	137.61	146.90	158.99	(62)

Solar DHW input calculated using Appendix G or Appendix H

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (63) |

Flue gas heat recovery system 1 input (Appendix G1)

| -33.40 | -27.39 | -24.43 | -15.48 | -10.97 | -8.09 | -7.49 | -8.61 | -8.71 | -17.93 | -26.85 | -33.50 | (63) |

Output from water heater for each month (kWh/month) (62)m + (63)m

| 129.42 | 114.84 | 123.54 | 115.76 | 116.10 | 103.83 | 99.73 | 110.92 | 112.14 | 119.68 | 120.05 | 125.50 | |

∑(64)1...12 = 1391.51 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

| 50.70 | 44.30 | 46.02 | 40.68 | 39.32 | 34.49 | 32.84 | 36.81 | 37.22 | 42.57 | 45.64 | 49.43 | (65) |

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	84.39	84.39	84.39	84.39	84.39	84.39	84.39	84.39	84.39	84.39	84.39	84.39	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.11	11.64	9.47	7.17	5.36	4.52	4.89	6.35	8.53	10.83	12.64	13.47	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	147.03	148.55	144.71	136.52	126.19	116.48	109.99	108.47	112.31	120.50	130.83	140.54	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.44	31.44	31.44	31.44	31.44	31.44	31.44	31.44	31.44	31.44	31.44	31.44	(69)
Pump and fan gains (Table 5a)													
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)													
	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	(71)
Water heating gains (Table 5)													
	68.15	65.92	61.85	56.50	52.84	47.91	44.14	49.47	51.70	57.22	63.39	66.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
	279.60	277.43	267.34	251.50	235.71	220.23	210.34	215.61	223.85	239.86	258.17	271.77	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

| 90.37 | 176.78 | 291.12 | 424.59 | 520.35 | 532.67 | 507.12 | 435.61 | 338.59 | 209.76 | 112.68 | 74.31 | (83) |

Total gains - internal and solar (73)m + (83)m

| 369.96 | 454.21 | 558.47 | 676.09 | 756.06 | 752.89 | 717.46 | 651.22 | 562.44 | 449.62 | 370.85 | 346.08 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C)   21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	1.00	0.99	0.96	0.87	0.70	0.51	0.37	0.43	0.70	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	19.73	19.95	20.30	20.69	20.91	20.98	21.00	20.99	20.94	20.58	20.08	19.69	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	19.87	19.87	19.87	19.88	19.89	19.89	19.89	19.90	19.89	19.89	19.88	19.88	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.95	0.83	0.63	0.43	0.28	0.33	0.61	0.91	0.99	1.00	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.20	18.53	19.03	19.55	19.81	19.89	19.89	19.89	19.85	19.43	18.71	18.15	(90)

Living area fraction   Living area ÷ (4) = **0.56** (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.06	19.33	19.75	20.19	20.43	20.50	20.51	20.51	20.46	20.08	19.48	19.02	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.91	19.18	19.60	20.04	20.28	20.35	20.36	20.36	20.31	19.93	19.33	18.87	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains, ηm

0.99	0.98	0.94	0.84	0.66	0.46	0.32	0.37	0.64	0.91	0.98	0.99	(94)

Useful gains, ηmGm, W (94)m x (84)m

366.82	444.77	525.61	564.66	497.81	348.51	230.73	241.84	360.99	409.89	364.34	343.86	(95)

Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

923.79	900.49	823.83	693.24	532.59	353.73	231.45	243.23	383.22	579.32	762.54	918.72	(97)

Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

414.39	306.24	221.88	92.58	25.87	0.00	0.00	0.00	0.00	126.06	286.71	427.70

∑(98)1...5, 10...12 = **1901.42** (98)

Space heating requirement kWh/m²/year   (98) ÷ (4) **38.09** (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)	**0.00**	(201)
Fraction of space heat from main system(s) 1 - (201) =	**1.00**	(202)
Fraction of space heat from main system 2	**0.00**	(202)
Fraction of total space heat from main system 1 (202) x [1- (203)] =	**1.00**	(204)
Fraction of total space heat from main system 2 (202) x (203) =	**0.00**	(205)
Efficiency of main system 1 (%)	**92.90**	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Space heating fuel (main system 1), kWh/month

446.06	329.65	238.83	99.66	27.85	0.00	0.00	0.00	0.00	135.69	308.62	460.39

∑(211)1...5, 10...12 = **2046.74** (211)

Water heating

Efficiency of water heater

90.28	89.91	89.02	87.00	84.47	82.80	82.80	82.80	82.80	87.69	89.67	90.40	(217)

Water heating fuel, kWh/month

143.35	127.73	138.78	133.06	137.44	125.40	120.45	133.97	135.44	136.48	133.87	138.83	

∑(219a)1...12 = **1604.79** (219)

Annual totals

Space heating fuel - main system 1	**2046.74**
Water heating fuel	**1604.79**

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	**30.00**	(230c)
boiler flue fan	**45.00**	(230e)

Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		231.48	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3958.02	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2046.74	x	3.48	x 0.01 =	71.23	(240)
Water heating	1604.79	x	3.48	x 0.01 =	55.85	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	231.48	x	13.19	x 0.01 =	30.53	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		287.50	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.27	(257)
SAP value	82.25	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO$_2$ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO$_2$/kWh		Emissions kg CO$_2$/year	
Space heating - main system 1	2046.74	x	0.22	=	442.10	(261)
Water heating	1604.79	x	0.22	=	346.64	(264)
Space and water heating			(261) + (262) + (263) + (264) =		788.73	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	231.48	x	0.52	=	120.14	(268)
Total CO$_2$, kg/year			(265)...(271) =		947.80	(272)
Dwelling CO$_2$ emission rate			(272) ÷ (4) =		18.99	(273)
EI value					86.62	
EI rating (section 14)					87	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2046.74	x	1.22	=	2497.03	(261)
Water heating	1604.79	x	1.22	=	1957.85	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4454.87	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	231.48	x	3.07	=	710.65	(268)
Primary energy kWh/year					5395.77	(272)
Dwelling primary energy rate kWh/m2/year					108.09	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 6 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		49.92	(1a) x	2.60	(2a) =	129.79	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.92	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		129.79	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	3	x 10 =	30	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.23	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.43	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48	x 1.33	= 16.55			(27)
External wall			27.82	x 0.16	= 4.45			(29a)
Party wall			46.28	x 0.00	= 0.00			(32)
Roof			49.92	x 0.15	= 7.49			(30)

Total area of external elements ∑A, m²	90.22	(31)
Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) = 28.48	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) = N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	9.42	(36)
Total fabric heat loss	(33) + (36) = 37.91	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	25.30	25.15	25.00	24.31	24.18	23.57	23.57	23.46	23.81	24.18	24.44	24.72	(38)
Heat transfer coefficient, W/K (37)m + (38)m	63.21	63.06	62.91	62.22	62.09	61.48	61.48	61.37	61.71	62.09	62.35	62.62	(39)

Average = ∑(39)1...12/12 = 62.22 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.27	1.26	1.26	1.25	1.24	1.23	1.23	1.23	1.24	1.24	1.25	1.25	(40)

Average = ∑(40)1...12/12 = 1.25 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.28	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	81.71	78.74	75.77	72.80	69.83	66.86	66.86	69.83	72.80	75.77	78.74	81.71	(44)

∑(44)1...12 = 891.41 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	121.18	105.98	109.36	95.35	91.49	78.95	73.16	83.95	84.95	99.00	108.07	117.35	(45)

∑(45)1...12 = 1168.78 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	18.18	15.90	16.40	14.30	13.72	11.84	10.97	12.59	12.74	14.85	16.21	17.60	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	41.64	36.24	38.61	35.90	35.58	32.97	34.07	35.58	35.90	38.61	38.83	41.64	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	162.82	142.22	147.98	131.25	127.07	111.92	107.22	119.53	120.85	137.61	146.90	158.99	(62)

Solar DHW input calculated using Appendix G or Appendix H

NHER

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Flue gas heat recovery system 1 input (Appendix G1)

-30.41	-25.01	-21.67	-13.81	-10.43	-8.09	-7.49	-8.61	-8.71	-15.47	-24.41	-30.55	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

132.41	117.21	126.30	117.43	116.64	103.83	99.73	110.92	112.14	122.14	122.49	128.44

∑(64)1...12 = 1409.69 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

50.70	44.30	46.02	40.68	39.32	34.49	32.84	36.81	37.22	42.57	45.64	49.43	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Metabolic gains (Table 5)

101.26	101.26	101.26	101.26	101.26	101.26	101.26	101.26	101.26	101.26	101.26	101.26	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

32.77	29.10	23.67	17.92	13.40	11.31	12.22	15.88	21.32	27.07	31.59	33.68	(67)

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

219.44	221.72	215.98	203.76	188.34	173.85	164.17	161.89	167.63	179.85	195.27	209.76	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

46.81	46.81	46.81	46.81	46.81	46.81	46.81	46.81	46.81	46.81	46.81	46.81	(69)

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)

Losses e.g. evaporation (Table 5)

-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	-67.51	(71)

Water heating gains (Table 5)

68.15	65.92	61.85	56.50	52.84	47.91	44.14	49.47	51.70	57.22	63.39	66.44	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

403.93	400.32	385.07	361.75	338.15	316.63	304.10	310.82	324.21	347.70	373.82	393.45	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

90.37	176.78	291.12	424.59	520.35	532.67	507.12	435.61	338.59	209.76	112.68	74.31	(83)

Total gains - internal and solar (73)m + (83)m

494.29	577.09	676.19	786.34	858.50	849.30	811.22	746.43	662.80	557.46	486.49	467.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.92	0.81	0.63	0.46	0.33	0.38	0.61	0.88	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.95	20.16	20.47	20.78	20.94	20.99	21.00	21.00	20.96	20.71	20.27	19.91	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.87	19.87	19.87	19.88	19.89	19.89	19.89	19.90	19.89	19.89	19.88	19.88	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.90	0.76	0.57	0.38	0.25	0.29	0.53	0.84	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.52	18.81	19.24	19.66	19.84	19.89	19.89	19.90	19.87	19.59	18.99	18.47	(90)

Living area fraction Living area ÷ (4) = **0.56** (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.32	19.57	19.93	20.29	20.46	20.51	20.52	20.52	20.48	20.22	19.71	19.28	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.17	19.42	19.78	20.14	20.31	20.36	20.37	20.37	20.33	20.07	19.56	19.13	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.98	0.95	0.90	0.77	0.60	0.41	0.28	0.32	0.56	0.85	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	482.23	550.37	607.58	608.13	511.35	350.81	231.08	242.55	371.91	471.92	464.91	458.50	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	940.24	915.64	835.62	699.26	534.38	354.04	231.50	243.34	384.68	588.08	776.83	934.90	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	340.76	245.46	169.66	65.61	17.14	0.00	0.00	0.00	0.00	86.42	224.58	354.44	

∑(98)1...5, 10...12 = **1504.07** (98)

Space heating requirement kWh/m²/year (98) ÷ (4) **30.13** (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) **0.00** (201)

Fraction of space heat from main system(s) 1 - (201) = **1.00** (202)

Fraction of space heat from main system 2 **0.00** (202)

Fraction of total space heat from main system 1 (202) x [1- (203)] = **1.00** (204)

Fraction of total space heat from main system 2 (202) x (203) = **0.00** (205)

Efficiency of main system 1 (%) **92.90** (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month												
	366.80	264.22	182.62	70.62	18.45	0.00	0.00	0.00	0.00	93.03	241.75	381.53

∑(211)1...5, 10...12 = **1619.02** (211)

Water heating

Efficiency of water heater

89.83	89.38	88.30	86.16	83.97	82.80	82.80	82.80	82.80	86.71	89.07	89.98	(217)

Water heating fuel, kWh/month

147.39	131.14	143.03	136.30	138.91	125.40	120.45	133.97	135.44	140.87	137.53	142.74	

∑(219a)1...12 = **1633.17** (219)

Annual totals

Space heating fuel - main system 1 **1619.02**

Water heating fuel **1633.17**

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit **30.00** (230c)

boiler flue fan **45.00** (230e)

Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			231.48	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	3558.67	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1619.02	x	3.48	x 0.01 =	56.34	(240)
Water heating	1633.17	x	3.48	x 0.01 =	56.83	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	231.48	x	13.19	x 0.01 =	30.53	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		273.60	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.21	(257)
SAP value	83.11	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO$_2$/kWh		Emissions kg CO$_2$/year	
Space heating - main system 1	1619.02	x	0.22	=	349.71	(261)
Water heating	1633.17	x	0.22	=	352.76	(264)
Space and water heating			(261) + (262) + (263) + (264) =		702.47	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	231.48	x	0.52	=	120.14	(268)
Total CO$_2$, kg/year			(265)...(271) =		861.54	(272)
Dwelling CO$_2$ emission rate			(272) ÷ (4) =		17.26	(273)
EI value					87.84	
EI rating (section 14)					88	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1619.02	x	1.22	=	1975.21	(261)
Water heating	1633.17	x	1.22	=	1992.46	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3967.67	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	231.48	x	3.07	=	710.65	(268)
Primary energy kWh/year					4908.57	(272)
Dwelling primary energy rate kWh/m2/year					98.33	(273)

DER Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 6 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		49.62	(1a) x	2.60	(2a) =	129.01	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.62	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		129.01	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.23	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.43	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] = 0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.34	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2													
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4													
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m													
	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.39	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48	x 1.33	= 16.55			(27)
External wall			27.82	x 0.16	= 4.45			(29a)
Party wall			46.28	x 0.00	= 0.00			(32)
Roof			49.62	x 0.12	= 5.95			(30)

Total area of external elements ∑A, m² **89.92** (31)

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = **26.95** (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = **N/A** (34)

Thermal mass parameter (TMP) in kJ/m²K **250.00** (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K **9.42** (36)

Total fabric heat loss (33) + (36) = **36.37** (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	25.18	25.02	24.88	24.18	24.05	23.45	23.45	23.33	23.68	24.05	24.31	24.59	(38)
Heat transfer coefficient, W/K (37)m + (38)m	61.55	61.40	61.25	60.56	60.43	59.82	59.82	59.71	60.05	60.43	60.69	60.96	

Average = ∑(39)1...12/12 = **60.55** (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.24	1.24	1.23	1.22	1.22	1.21	1.21	1.20	1.21	1.22	1.22	1.23	

Average = ∑(40)1...12/12 = **1.22** (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N **1.68** (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 **74.07** (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	81.48	78.52	75.56	72.59	69.63	66.67	66.67	69.63	72.59	75.56	78.52	81.48	

∑(44)1...12 = **888.89** (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	120.84	105.68	109.06	95.08	91.23	78.72	72.95	83.71	84.71	98.72	107.76	117.02	

∑(45)1...12 = **1165.48** (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	18.13	15.85	16.36	14.26	13.68	11.81	10.94	12.56	12.71	14.81	16.16	17.55	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel **125.00** (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day) **0.01** (51)

Volume factor from Table 2a **0.99** (52)

Temperature factor from Table 2b **0.54** (53)

Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) **0.77** (54)

Enter (50) or (54) in (55) **0.77** (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

| 23.84 | 21.53 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | (57) |

Primary circuit loss for each month from Table 3

| 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss for each month from Table 3a, 3b or 3c

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (61) |

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

| 167.93 | 148.22 | 156.15 | 140.66 | 138.33 | 124.30 | 120.05 | 130.81 | 130.29 | 145.82 | 153.34 | 164.12 | (62) |

Solar DHW input calculated using Appendix G or Appendix H

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (63) |

Output from water heater for each month (kWh/month) (62)m + (63)m

| 167.93 | 148.22 | 156.15 | 140.66 | 138.33 | 124.30 | 120.05 | 130.81 | 130.29 | 145.82 | 153.34 | 164.12 | |

∑(64)1...12 =   1720.03   (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45) + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

| 77.86 | 69.17 | 73.94 | 68.08 | 68.01 | 62.64 | 61.93 | 65.51 | 64.63 | 70.50 | 72.29 | 76.59 | (65) |

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	83.95	83.95	83.95	83.95	83.95	83.95	83.95	83.95	83.95	83.95	83.95	83.95	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| 13.04 | 11.58 | 9.42 | 7.13 | 5.33 | 4.50 | 4.86 | 6.32 | 8.48 | 10.77 | 12.57 | 13.40 | (67) |

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| 146.25 | 147.76 | 143.94 | 135.80 | 125.52 | 115.86 | 109.41 | 107.89 | 111.72 | 119.86 | 130.14 | 139.79 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| 31.39 | 31.39 | 31.39 | 31.39 | 31.39 | 31.39 | 31.39 | 31.39 | 31.39 | 31.39 | 31.39 | 31.39 | (69) |

Pump and fan gains (Table 5a)

| 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | (70) |

Losses e.g. evaporation (Table 5)

| -67.16 | -67.16 | -67.16 | -67.16 | -67.16 | -67.16 | -67.16 | -67.16 | -67.16 | -67.16 | -67.16 | -67.16 | (71) |

Water heating gains (Table 5)

| 104.65 | 102.94 | 99.38 | 94.55 | 91.42 | 87.00 | 83.25 | 88.06 | 89.76 | 94.76 | 100.41 | 102.94 | (72) |

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| 315.12 | 313.46 | 303.92 | 288.66 | 273.45 | 258.55 | 248.70 | 253.45 | 261.15 | 276.58 | 294.30 | 307.32 | (73) |

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

| 90.37 | 176.78 | 291.12 | 424.59 | 520.35 | 532.67 | 507.12 | 435.61 | 338.59 | 209.76 | 112.68 | 74.31 | (83) |

Total gains - internal and solar (73)m + (83)m

| 405.48 | 490.24 | 595.05 | 713.25 | 793.80 | 791.21 | 755.82 | 689.06 | 599.74 | 486.33 | 406.97 | 381.63 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)   21.00   (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.98	0.95	0.84	0.66	0.48	0.35	0.40	0.65	0.91	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.84	20.05	20.39	20.75	20.93	20.99	21.00	21.00	20.95	20.66	20.17	19.80	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.89	19.89	19.89	19.90	19.91	19.92	19.92	19.92	19.91	19.91	19.90	19.90	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.93	0.80	0.60	0.40	0.26	0.30	0.56	0.88	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.37	18.68	19.16	19.64	19.85	19.91	19.91	19.92	19.88	19.54	18.86	18.32	(90)

Living area fraction — Living area ÷ (4) = **0.57** (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.20	19.46	19.86	20.27	20.46	20.52	20.53	20.53	20.49	20.17	19.61	19.15	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.20	19.46	19.86	20.27	20.46	20.52	20.53	20.53	20.49	20.17	19.61	19.15	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.97	0.93	0.81	0.63	0.44	0.31	0.36	0.61	0.89	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	400.68	476.99	552.49	579.40	501.58	350.12	234.41	245.37	366.37	433.25	397.14	378.12	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	916.96	893.96	818.24	688.30	529.46	354.15	234.98	246.45	383.66	578.41	758.91	911.69	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	384.11	280.20	197.72	78.40	20.74	0.00	0.00	0.00	0.00	108.00	260.47	396.98	

∑(98)1...5, 10...12 = **1726.64** (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) **34.80** (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)	0.00	(201)
Fraction of space heat from main system(s)	1 - (201) = 1.00	(202)
Fraction of space heat from main system 2	0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] = 1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) = 0.00	(205)
Efficiency of main system 1 (%)	249.90	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	153.71	112.13	79.12	31.37	8.30	0.00	0.00	0.00	0.00	43.22	104.23	158.85

∑(211)1...5, 10...12 = **690.93** (211)

Water heating

Efficiency of water heater

175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	(217)

Water heating fuel, kWh/month

95.91	84.65	89.18	80.33	79.00	70.99	68.56	74.71	74.41	83.28	87.57	93.73	

∑(219a)1...12 = **982.31** (219)

Annual totals

Space heating fuel - main system 1	690.93	
Water heating fuel	982.31	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
Total electricity for the above, kWh/year	30.00	(231)
Electricity for lighting (Appendix L)	230.26	(232)
Energy saving/generation technologies		
electricity generated by PV (Appendix M)	-823.35	(233)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 1110.15	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	690.93	x	13.19	x 0.01 =	91.13	(240)
Water heating	982.31	x	13.19	x 0.01 =	129.57	(247)
Pumps and fans	30.00	x	13.19	x 0.01 =	3.96	(249)
Electricity for lighting	230.26	x	13.19	x 0.01 =	30.37	(250)
Additional standing charges					0.00	(251)
Energy saving/generation technologies						
pv savings	-823.35	x	13.19	x 0.01 =	0.00	(252)
Total energy cost			(240)...(242) + (245)...(254) =		255.03	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.13	(257)
SAP value	84.21	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	690.93	x	0.52	=	358.59	(261)
Water heating	982.31	x	0.52	=	509.82	(264)
Space and water heating			(261) + (262) + (263) + (264) =		868.41	(265)
Pumps and fans	30.00	x	0.52	=	15.57	(267)
Electricity for lighting	230.26	x	0.52	=	119.50	(268)
Energy saving/generation technologies						
pv savings	-823.35	x	0.52	=	-427.32	(269)
Total CO_2, kg/year			(265)...(271) =		576.17	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		11.61	(273)
EI value					91.84	
EI rating (section 14)					92	(274)
EI band					A	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	690.93	x	3.07	=	2121.16	(261)

Water heating	982.31	x	3.07	=	3015.71	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5136.87	(265)
Pumps and fans	30.00	x	3.07	=	92.10	(267)
Electricity for lighting	230.26	x	3.07	=	706.88	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-823.35	x	3.07	=	-2527.68	(269)
Primary energy kWh/year					3408.17	(272)
Dwelling primary energy rate kWh/m2/year					68.69	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Pete Mitchell	Assessor number	3635
Client		Last modified	08/03/2016
Address	Unit 6 1a Highgate Road, London, NW5 1JY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		49.62	(1a) x	2.60	(2a) =	129.01	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.62	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		129.01	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.23	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.43	(18)
Number of sides on which the dwelling is sheltered	3	(19)
Shelter factor	1 - [0.075 x (19)] = 0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.34	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.39	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.48 x	1.33 =	16.55			(27)
External wall			27.82 x	0.16 =	4.45			(29a)
Party wall			46.28 x	0.00 =	0.00			(32)
Roof			49.62 x	0.12 =	5.95			(30)

Total area of external elements ∑A, m²	89.92	(31)
Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) =	26.95	(33)
Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K	250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K	9.42	(36)
Total fabric heat loss (33) + (36) =	36.37	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	25.18	25.02	24.88	24.18	24.05	23.45	23.45	23.33	23.68	24.05	24.31	24.59	(38)
Heat transfer coefficient, W/K (37)m + (38)m	61.55	61.40	61.25	60.56	60.43	59.82	59.82	59.71	60.05	60.43	60.69	60.96	

Average = ∑(39)1...12/12 = 60.55 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.24	1.24	1.23	1.22	1.22	1.21	1.21	1.20	1.21	1.22	1.22	1.23

Average = ∑(40)1...12/12 = 1.22 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.68	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.07	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	81.48	78.52	75.56	72.59	69.63	66.67	66.67	69.63	72.59	75.56	78.52	81.48

∑(44)1...12 = 888.89 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	120.84	105.68	109.06	95.08	91.23	78.72	72.95	83.71	84.71	98.72	107.76	117.02

∑(45)1...12 = 1165.48 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	18.13	15.85	16.36	14.26	13.68	11.81	10.94	12.56	12.71	14.81	16.16	17.55	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	125.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	0.99	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.77	(54)
Enter (50) or (54) in (55)	0.77	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	23.84	21.53	23.84	23.07	23.84	23.07	23.84	23.84	23.07	23.84	23.07	23.84	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

| 23.84 | 21.53 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | 23.84 | 23.07 | 23.84 | 23.07 | 23.84 | (57) |

Primary circuit loss for each month from Table 3

| 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss for each month from Table 3a, 3b or 3c

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (61) |

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

| 167.93 | 148.22 | 156.15 | 140.66 | 138.33 | 124.30 | 120.05 | 130.81 | 130.29 | 145.82 | 153.34 | 164.12 | (62) |

Solar DHW input calculated using Appendix G or Appendix H

| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (63) |

Output from water heater for each month (kWh/month) (62)m + (63)m

| 167.93 | 148.22 | 156.15 | 140.66 | 138.33 | 124.30 | 120.05 | 130.81 | 130.29 | 145.82 | 153.34 | 164.12 |

∑(64)1...12 = 1720.03 (64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

| 77.86 | 69.17 | 73.94 | 68.08 | 68.01 | 62.64 | 61.93 | 65.51 | 64.63 | 70.50 | 72.29 | 76.59 | (65) |

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	100.74	100.74	100.74	100.74	100.74	100.74	100.74	100.74	100.74	100.74	100.74	100.74	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.60	28.95	23.54	17.82	13.32	11.25	12.15	15.80	21.21	26.93	31.43	33.50	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	218.28	220.54	214.84	202.68	187.35	172.93	163.30	161.03	166.74	178.89	194.23	208.65	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.75	46.75	46.75	46.75	46.75	46.75	46.75	46.75	46.75	46.75	46.75	46.75	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	-67.16	(71)
Water heating gains (Table 5)	104.65	102.94	99.38	94.55	91.42	87.00	83.25	88.06	89.76	94.76	100.41	102.94	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	438.85	435.76	421.09	398.39	375.42	354.51	342.03	348.22	361.04	383.91	409.40	428.42	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	9.60	x	19.64	x 0.9 x	0.76	x	0.70	=	69.51	(80)
East	0.77	x	2.88	x	19.64	x 0.9 x	0.76	x	0.70	=	20.85	(76)

Solar gains in watts ∑(74)m...(82)m

| 90.37 | 176.78 | 291.12 | 424.59 | 520.35 | 532.67 | 507.12 | 435.61 | 338.59 | 209.76 | 112.68 | 74.31 | (83) |

Total gains - internal and solar (73)m + (83)m

| 529.22 | 612.54 | 712.22 | 822.98 | 895.76 | 887.18 | 849.15 | 783.83 | 699.63 | 593.67 | 522.07 | 502.74 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C)   21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.96	0.90	0.78	0.60	0.43	0.31	0.35	0.57	0.85	0.96	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.05	20.25	20.54	20.82	20.96	20.99	21.00	21.00	20.97	20.77	20.36	20.01	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.89	19.89	19.89	19.90	19.91	19.92	19.92	19.92	19.91	19.91	19.90	19.90	(88)

Utilisation factor for gains for rest of dwelling $n_{2,m}$

0.97	0.95	0.88	0.73	0.54	0.36	0.23	0.27	0.49	0.80	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.67	18.96	19.36	19.72	19.87	19.91	19.92	19.92	19.89	19.67	19.13	18.62	(90)

Living area fraction	Living area ÷ (4) =	0.57	(91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.45	19.69	20.03	20.35	20.48	20.52	20.53	20.53	20.51	20.29	19.82	19.41	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.45	19.69	20.03	20.35	20.48	20.52	20.53	20.53	20.51	20.29	19.82	19.41	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, η_m	0.97	0.94	0.88	0.75	0.57	0.40	0.28	0.31	0.54	0.82	0.94	0.97	(94)

Useful gains, $\eta_m G_m$, W (94)m x (84)m

512.91	578.14	628.41	616.98	512.37	351.84	234.67	245.90	374.70	488.01	493.08	489.93	(95)

Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

932.68	908.17	828.79	693.19	530.78	354.36	235.01	246.52	384.66	585.74	772.24	927.21	(97)

Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

312.31	221.78	149.08	54.88	13.70	0.00	0.00	0.00	0.00	72.71	200.99	325.34

∑(98)1…5, 10…12 =	1350.77	(98)

Space heating requirement kWh/m²/year	(98) ÷ (4)	27.22	(99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		249.90	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month												
124.97	88.75	59.66	21.96	5.48	0.00	0.00	0.00	0.00	29.10	80.43	130.19

∑(211)1…5, 10…12 =	540.53	(211)

Water heating

Efficiency of water heater

175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	175.10	(217)

Water heating fuel, kWh/month

95.91	84.65	89.18	80.33	79.00	70.99	68.56	74.71	74.41	83.28	87.57	93.73

∑(219a)1…12 =	982.31	(219)

Annual totals

Space heating fuel - main system 1	540.53	
Water heating fuel	982.31	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
Total electricity for the above, kWh/year	30.00	(231)
Electricity for lighting (Appendix L)	230.26	(232)
Energy saving/generation technologies		
electricity generated by PV (Appendix M)	-823.35	(233)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 959.75	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	540.53	x	13.19	x 0.01 =	71.30	(240)
Water heating	982.31	x	13.19	x 0.01 =	129.57	(247)
Pumps and fans	30.00	x	13.19	x 0.01 =	3.96	(249)
Electricity for lighting	230.26	x	13.19	x 0.01 =	30.37	(250)
Additional standing charges					0.00	(251)
Energy saving/generation technologies						
pv savings	-823.35	x	13.19	x 0.01 =	0.00	(252)
Total energy cost			(240)...(242) + (245)...(254) =		235.19	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.04	(257)
SAP value	85.44	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	540.53	x	0.52	=	280.53	(261)
Water heating	982.31	x	0.52	=	509.82	(264)
Space and water heating			(261) + (262) + (263) + (264) =		790.35	(265)
Pumps and fans	30.00	x	0.52	=	15.57	(267)
Electricity for lighting	230.26	x	0.52	=	119.50	(268)
Energy saving/generation technologies						
pv savings	-823.35	x	0.52	=	-427.32	(269)
Total CO_2, kg/year			(265)...(271) =		498.11	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		10.04	(273)
EI value					92.95	
EI rating (section 14)					93	(274)
EI band					A	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	540.53	x	3.07	=	1659.41	(261)

NHER

Water heating	982.31	x	3.07	=	3015.71	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4675.12	(265)
Pumps and fans	30.00	x	3.07	=	92.10	(267)
Electricity for lighting	230.26	x	3.07	=	706.88	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-823.35	x	3.07	=	-2527.68	(269)
Primary energy kWh/year					2946.42	(272)
Dwelling primary energy rate kWh/m2/year					59.38	(273)

NHER